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Sep 79

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AN AFFILIATE OF SIEMENS

The Intelligent Display™

March 1979

THE LITRONIX INTELLIGENT DISPLAY^{TM*}

Improving man-machine communications

Litronix intelligent displays provide the electro-optical link from microprocessor based products to humans. Intelligent displays are compact modular components that convert computer data to readable letters and numbers. They enable machines to communicate with man in words, sentences and even paragraphs. Litronix displays combine CMOS ICs, hybrid construction and display technology to improve product performance and greatly simplify system design. They drastically reduce system costs and enable products to be built that weren't practical before. Intelligent displays are improving the man-machine interface.

Following the microprocessor

The intelligent display parallels and is an extension of the microprocessor evolution. At the time microprocessors were introduced, they were considered another way of doing something already being done with logic. As prices dropped and more and more designers learned how to use microprocessors they found they could afford to apply computer based electronics to many new applications. In effect the microprocessor helped develop entirely new markets. And the microprocessor helped engineers reduce design time and bring their products to market faster.

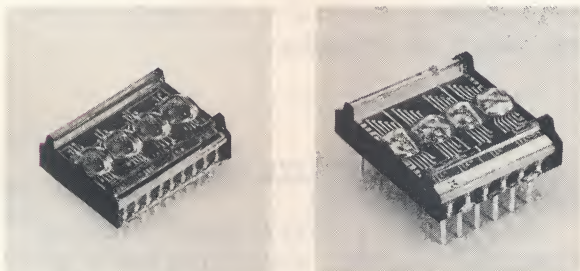


Figure 1

DL1414 and DL2416 intelligent displays

Today intelligent displays (figure 1) are at the same point in their evolution as the microprocessor was in 1972. Engineers are just beginning to use them. Initially Litronix intelligent displays were selected on the basis of small size. Because for the first time they made it possible for a designer to include alphanumeric displays in a hand held or other portable product - where space was at a premium. In effect, the first Litronix intelligent displays helped create new markets. For example, they made it possible to design products, capable of communicating with people, and do that job on a cost effective basis - still meeting the rigid packaging requirement that the entire product (including display), must fit in the palm of the hand. And like the microprocessor, the intelligent display is helping engineers reduce design time and bring their products to market sooner.

Just the Beginning

Because of the size and cost advantages, intelligent displays are finding their way into a variety of applications pioneered by the microprocessor. In dedicated controllers for example, Litronix intelligent displays can improve the user interface by making it possible to display status words, diagnostic instructions - even provide guidance to the user when such instructions enhance system performance.

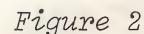
Microprocessor based products are moving into banks, retail stores, police cars, doctor's offices, schools ... etc. And in many of these applications there is the need to communicate with people in understandable form ... plain English. Even operating instructions can be presented to the user - providing step-by-step instructions on how to use the product - in everyday language. And with a keyboard plus the intelligent display, the communications can become interactive.

* Intelligent Display is a trademark of Litronix.

Litronix intelligent displays offer a means to build uncluttered front panels. Display modules can be placed side by side to present 8, 12, 16, 20, 40 or more alphanumeric digits. These compact displays give the system designer a great deal of flexibility. For example, a microprocessor feeding a 20 digit display can break the message into 20 character segments and present them one after the other - talking to the user in understandable English words and sentences.

The first intelligent display -
it acts like a RAM

The DL1416 is a four character module built on a 1.2 x 1.0 inch p.c. card. The circuit accepts 64 character ASCII input and stores each character in RAM (figure 2). It then repeatedly sequences through the RAM, translating the data from ASCII to 16 segments and driving the LED display. The computer treats the DL1416 like a RAM. It addresses each digit and commands which ASCII character is to be presented in each position. The computer then ignores the display while going about its other functions and the DL1416 continues to display the characters.



As an extra feature the DL1416 includes a cursor which can override a character, turning on all 16 segments of selected digits. A common application of the cursor in text editing where it indicates the location of the next character to be entered. A new character can be entered while the cursor is present so that when the cursor is removed the new character appears. If a new character is not entered, the previous character reappears. In the DL1416, the digits appear 160 mils high after being magnified to increase apparent size and intensity. The unit operates from a single 5v supply and power consumption is low, typically 9 ma/digit of text, 0.5-1 ma/digit in standby.

The Litronix intelligent display combines several technologies - a CMOS LSI integrated circuit, monolithic LED displays and plastic immersion optics. These are interconnected using hybrid assembly techniques (figure 3).

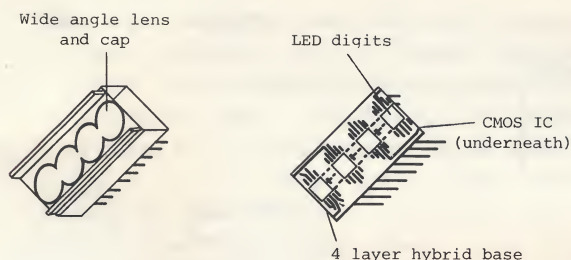


Figure 3

DL2416 and DL1414 construction. These new Litronix intelligent displays combine hybrid construction, LSI CMOS circuits and LED segmented displays in one modular package.

Litronix intelligent displays are the most cost effective approach available because Litronix has all the technologies needed (CMOS LSI, LED advanced optics, hybrid, etc.) to do the complete job in-house.

Now, the second generation - even smaller

Two new second generation displays, the DL2416 and the DL1414 provide all the advantages of the original DL1416 but in smaller packages - thus reducing the required panel space.

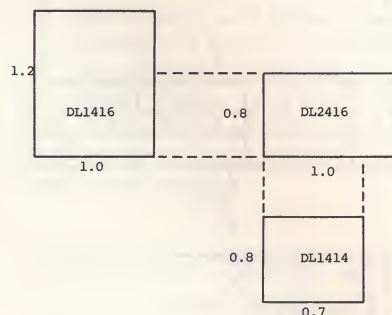


Figure 4

Size comparison. The new DL2416 has the same size digits as the original DL1416, but the hybrid package reduces panel space requirements by 33%. The DL1414 with smaller digits more than halves the space allocation, down to 46%.

The new DL2416 has the same height characters as the original DL1416 (160 mil). By using double-sided, four conducting layer hybrid construction the size of the package and panel space required is reduced by 33% (figure 4).

The new DL1414 is even smaller. The smaller 112 mil high digits are only 0.175" apart. That makes it possible to fit 20 characters, side-by-side in 3.5" - little more than the width of a hand held calculator.

In intelligent displays the number of external connections are minimized. Each intelligent display module provides the complex interconnection from 7 data and 2 digit address lines through internal electronics to 64+ LED segments. Both new generation products, the DL2416 and DL1414, include a 17th segment. The extra segment is a dot, enhancing the appearance of the decimal point/period and exclamation mark, while retaining the advantages of a line segment format for letters and numbers (figure 5).

CHARACTER SET									
	D0	L	H	L	H	L	H	L	H
	D1	L	L	H	H	L	L	H	H
	D2	L	L	L	L	H	H	H	H
D6 D5 D4 D3									
L H L L		!	"	#	\$	%	&	'	
L H L H		<	>	*	+	,	-	.	/
L H H L		0	1	2	3	4	5	6	7
L H H H		8	9	:	;	/	=	>	?
H L L L		@	A	B	C	D	E	F	G
H L L H		H	I	J	K	L	M	N	O
H L H L		P	Q	R	S	T	U	V	W
H L H H		X	Y	Z	[	\	]	^	_

Figure 5

The DL1414 and DL2416 character set includes a dot for the decimal point/period and for the exclamation mark.

Cost advantages - and more

Until the introduction of the intelligent display an engineer had little choice but to buy individual alphanumeric LED devices, then design the additional memory, decoders, drivers and interface circuits - using MSI circuits. The introduction of intelligent displays has cost advantages comparable to the advance from small scale integration to large scale integration integrated circuits. Similarly, intelligent displays shorten the OEM product development cycle and reduce production costs. The product development cycle is often shortened 1-4 engineering months, and a corresponding number of support man-months, because the designers do not need to develop and lay out the circuits already in the display. These savings can bring the OEM product to market sooner, and engineers can start work on the next product earlier.

Considering production costs, in relatively small volumes intelligent displays cost \$3-\$4 per digit and many high volume users will find their cost approaches \$2/digit or

less. In the same volume, the LED digits alone without any of the interface electronics would cost about \$1.80/digit. That doesn't leave much money for the electronics, packaging, etc.

An engineer setting out to build his own "do-it-yourself" electronics from available ICs, assuming a 16-digit display and 250 systems, would find that each system needed at least 12 ICs plus the readout. The total parts cost including LED displays would be approximately \$65. A comparable intelligent display system would require only one extra device, an address decoder, and at \$12/4-digit display the total parts cost would be approximately \$50 (figures 6a-c). In this example the use of intelligent displays results in a 23% savings, or looking at it another way, it costs a minimum of \$15 more to do it the hard way! When the costs of circuit boards, interconnections, parts stocking, handling and component insertion are considered, the savings become even more dramatic.

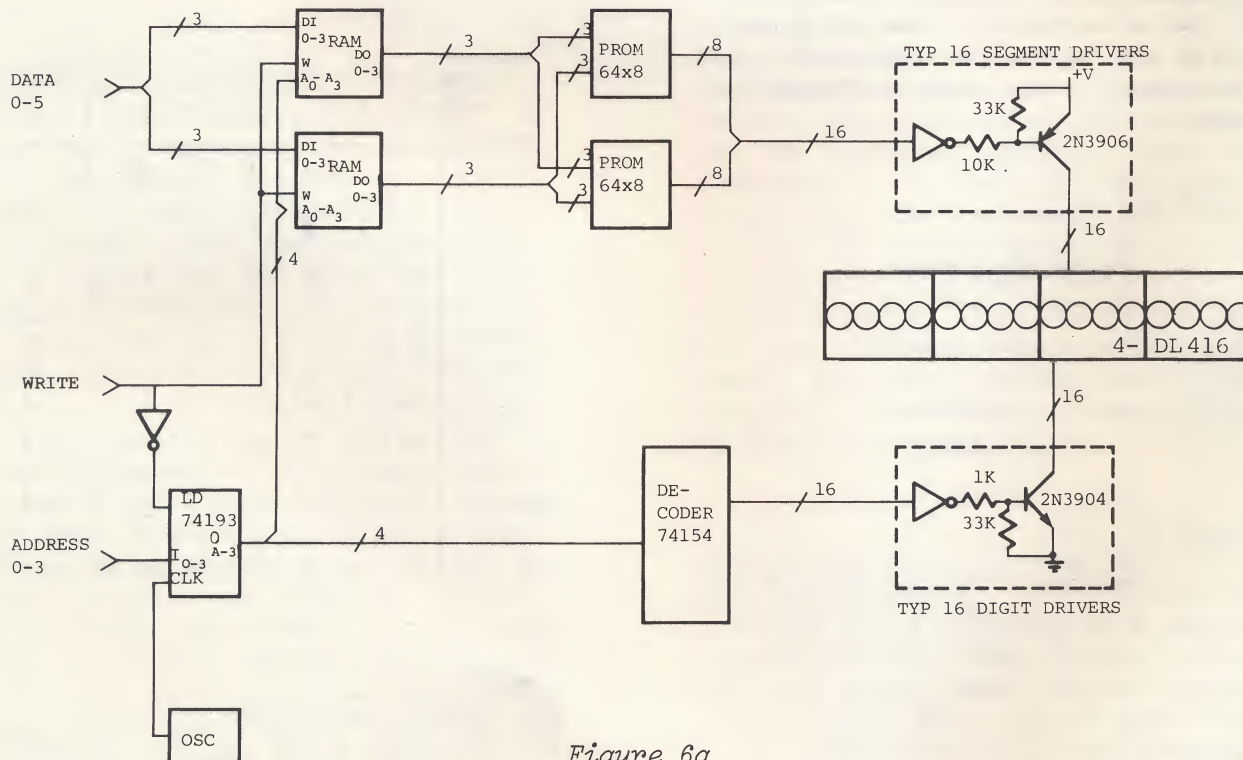


Figure 6a

16-digit system, do-it-yourself approach

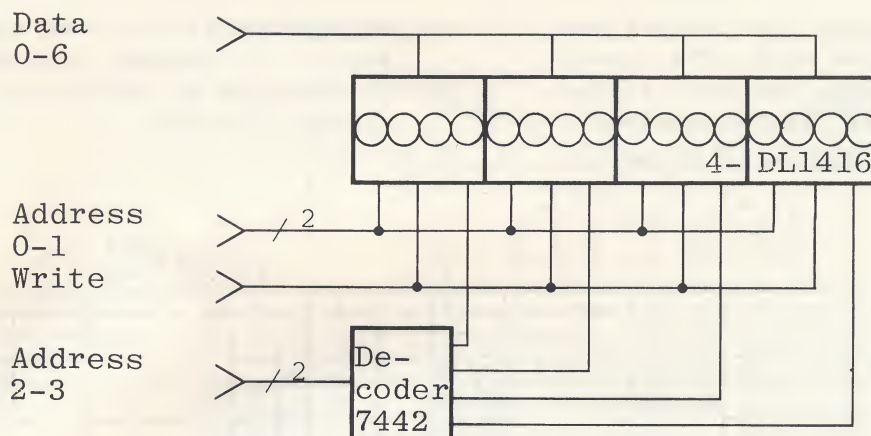


Figure 6b

16-digit system, using Intelligent Displays

Cost Comparison

Do-it-yourself

4 LED Displays DL416
 4 4x8 RAM CD4036
 2 64x8 PROM 74186
 1 Decoder 74154
 1 Binary Counter 74193
 3 Inverter CD4049
 1 NAND Gate CD4011
 16 PNP Transistors
 16 NPN Transistors
 64 Resistors

Parts Cost \$64.00 per system

Intelligent Display

4 Intelligent Displays DL1416
 1 Decoder 7442

Parts Cost \$50.00 per system

Figure 6c

Comparison of do-it-yourself electronics versus intelligent displays, based on a 16 digit system, production of 250 systems. Circuit boards, labor and overhead are ignored.

Figure 7 compares the cost of intelligent displays with CRTs. Note that for very large numbers of characters the CRT is less expensive. Intelligent displays will normally

be applied in the 8-80 character range. If needed, long messages can be conveyed by presenting sequential blocks of words.

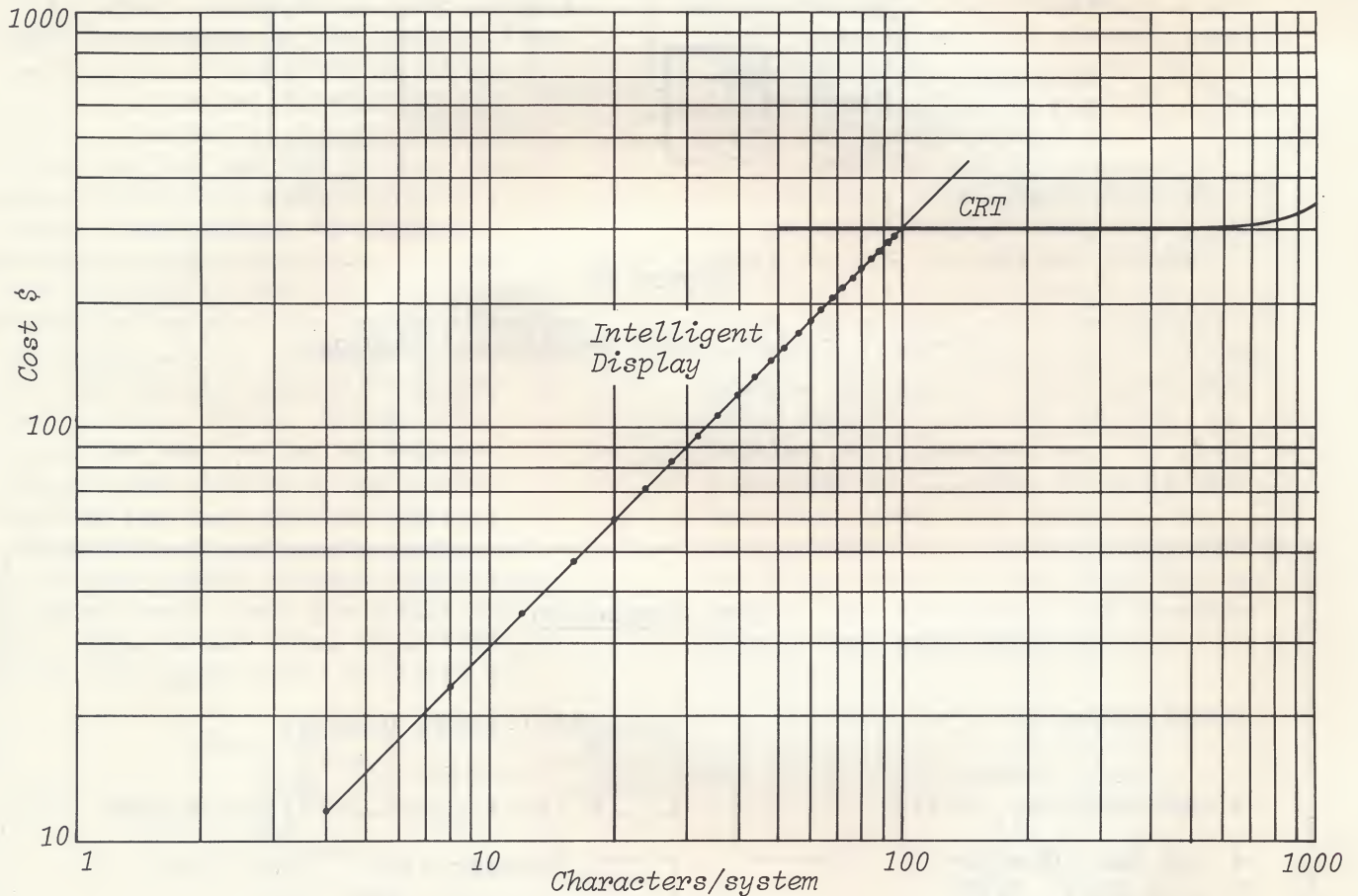


Figure 7

Applications

Many of the applications for intelligent displays are those where nothing else could do the job: handheld computer terminals, remote controls for large systems, portable units for grocery store inventory management, message units for police cars. As an example, figure 8 shows a mini-terminal built by DL Hester, Micro Computer Systems. This terminal receives and transmits serial

ASCII data at 300 baud. It displays 128 characters. Note the simplicity of the circuit, a tribute both to the microprocessor design and to the displays. This is typical of many applications; keyboards and intelligent displays are frequently used together. It is sometimes said that the way to control anything is with a keyboard and an intelligent display.

ALPHA-NUMERIC DISPLAY (4 to 128 Char.)

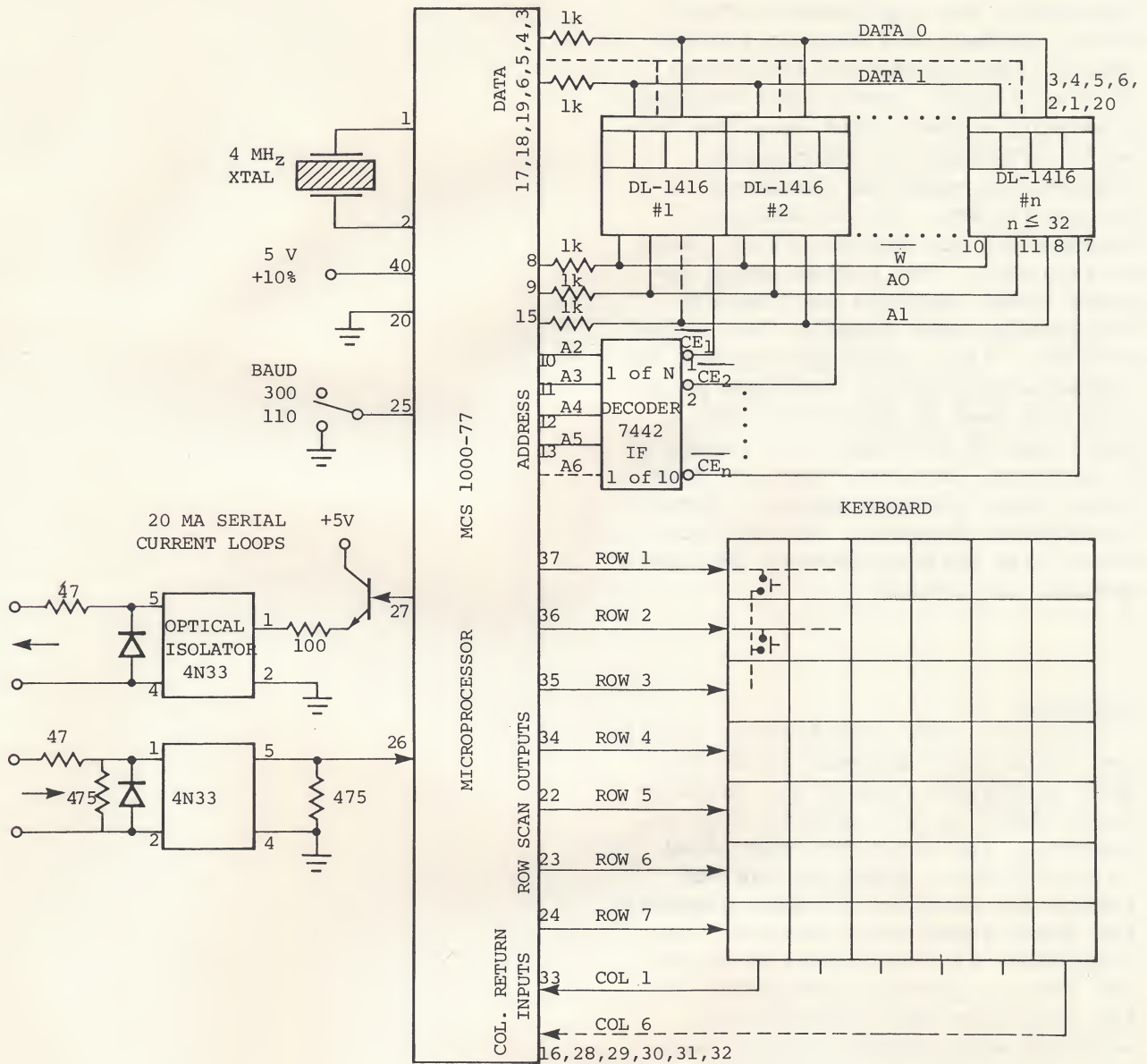


Figure 8

This mini-terminal is typical of many applications where keyboards and intelligent displays are used together.

To give an idea of how far this can go, auto makers are seriously discussing the replacement of all dials, guages, and warning lights (except the speedometer/odometer) with a 16 digit intelligent display. A warning buzzer would draw the driver's attention to emergencies. Information would be displayed in priority order. In an emergency, suggestions for driver action could be included. The system would require fewer controls and provide information more rapidly than other methods. Also, since the system is software-controlled, the same panel could be used in many cars with a multitude of options. The points to be observed here are that the displays (plus microprocessors) permit new ways of thinking, and the auto makers are serious because the cost savings are present.

Tomorrow

Since the first intelligent display was introduced, package sizes have been decreased, toward the ultimate limit which is the area of display. Recently, the extra dot was added to the readout, pointing the way toward the addition of more segments for upper/lower case letters. Undoubtedly, as intelligent displays are used in portable products, market pressures will increase for versions with liquid crystal readout, as occurred in calculators. And as usage rises there will be demands for various digit sizes, including large units.

One thing is certain. The intelligent display, like the microprocessor, will open up new areas for the application of electronics. And it's really just the beginning.

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Sep 79

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**DOMESTIC OEM
SUGGESTED RESALE PRICES**

MARCH 1, 1979

Suggested Resale Price List Effective March 1, 1979

Part Number	Description	1-99	100-999	1000
004-9002	Clip, T1½, Black			.02
004-9003	Clip, T1½, Clear			.02
004-9004	Clip, RL-2, Black			.02
004-9005	Clip, RL-2, Clear			.02
004-9011	Clip, T1, Black, Litronix			.02
004-9015	Clip, T1, Clear, Siemens			.02
004-9016	Clip, T1, Black, Siemens			.02
4N25	Isolator, Sngl., 40% Ctr, 4000V	.95	.68	.58
4N26	Isolator, Sngl., 20% Ctr, 1500V	.95	.68	.58
4N27	Isolator, Sngl., 10% Ctr, 1500V	.87	.62	.54
4N28	Isolator, Sngl., 10% Ctr, 500V	.75	.55	.48
4N32	Isolator, Sngl., 500%, 2500V	1.55	1.10	.95
4N32A	Isolator, Sngl., 500%, 2500V	1.55	1.10	.95
4N33	Isolator, Sngl., 500%, 1500V	1.60	1.15	1.00
BK1416	Intelligent Display Kit	Any Quantity	135.00	
BP103B-1	Photo Xtr, T1½, 55°, .125 mA	.70	.60	.50
BP103B-2	Photo Xtr, T1½, 55°, .2 mA	.76	.65	.54
BP103B-3	Photo Xtr, T1½, 55°, .32 mA	.84	.72	.60
BP103B-4	Photo Xtr, T1½, 55°, .5 mA	.95	.82	.68
BP104	Photo Diode, .71 pA, 10 nS	2.15	1.85	1.70
BPW 32	Photo Diode, 10 nA, 1000 nS	2.95	2.75	2.50
BPW 33	Photo Diode, 35 nA, 1000 nS	4.20	3.70	3.35
BPW 34	Photo Diode, 50 nA, 50 nS	2.50	2.20	2.00
BPX38-1	Photo Xtr, T0-18, 40°, .32 mA	1.60	1.20	1.10
BPX38-2	Photo Xtr, T0-18, 40°, .50 mA	1.90	1.60	1.35
BPX38-3	Photo Xtr, T0-18, 40°, .80 mA	3.60	2.70	2.40
BPX38-4	Photo Xtr, T0-18, 40°, 1.28 mA	4.10	3.10	2.70
BPX43-1	Photo Xtr, T0-18, 40°, 1.28 mA	1.60	1.20	1.05
BPX43-2	Photo Xtr, T0-18, 18°, 2.0 mA	1.90	1.60	1.35
BPX43-3	Photo Xtr, T0-18, 18°, 3.2 mA	3.00	2.20	1.90
BPX43-4	Photo Xtr, T0-18, 18°, 5.0 mA	3.60	2.70	2.30
BPX48	Photo Diode, 4 Lead, 15 nA, 150 nS	7.85	6.90	6.30
BPX60	Photo Diode, 2 Lead, 35 nA, 1000 nS	5.40	4.50	4.30
BPX61	Photo Diode, 2 Lead, 50 nA, 50 nS	7.00	5.90	5.60
BPX63	Photo Diode, T0-18, 10 nA, 1000 nS	2.15	1.85	1.70
BPX65	Photo Diode, T0-18, 7 nA, 1 nS	7.50	6.40	6.00
BPX66	Photo Diode, T0-18, 5 nA, .5 nS	8.90	7.80	7.10
BPX79	Photo Voltaic, .1 µA	4.60	4.00	3.70
BPX80	Photo Xtr, 10 Chip Array	13.00	11.00	9.30
BPX81-1	Photo Xtr, Min. 18°, .5 mA	.75	.62	.53
BPX81-2	Photo Xtr, Min. 18°, .8 mA	.80	.67	.57
BPX81-3	Photo Xtr, Min. 18°, 1.28 mA	.90	.75	.64
BPX81-4	Photo Xtr, Min. 18°, 2.0 mA	1.00	.83	.72
BPX82	Photo Xtr, 2 Chip Array	1.80	1.50	1.25
BPX83	Photo Xtr, 3 Chip Array	3.00	2.50	2.10
BPX84	Photo Xtr, 4 Chip Array	4.00	3.40	2.90
BPX85	Photo Xtr, 5 Chip Array	5.50	4.50	3.90
BPX86	Photo Xtr, 6 Chip Array	6.50	5.20	4.40
BPX87	Photo Xtr, 7 Chip Array	8.50	6.50	5.50
BPX88	Photo Xtr, 8 Chip Array	9.50	8.00	6.80
BPX89	Photo Xtr, 9 Chip Array	10.50	8.80	7.50
BPX90	Photo Diode, 2 Lead, 25 nA, 800 nS	2.55	2.25	2.05
BPX91	Photo Diode, 2 Lead, 35 nA, 1000 nS	3.30	2.80	2.65
BPX92	Photo Diode, 2 Lead, 4 nA, 800 nS	3.20	2.75	2.60
BPX93	Photo Diode, 2 Lead, 5 nA, 800 nS	2.95	2.50	2.35

▲New Product

●New Product available 2nd quarter 1979

□Not carried in stock.

Available upon special order only.

Min. order: \$500.00

Terms: Net 30 days F.O.B. Cupertino

All prices subject to change without notice.

Part Number	Description	1-99	100-999	1000
BPY11P-4	Photo Voltaic, 28 nA, 1K = 4.7 µA	2.55	2.20	1.90
BPY11P-5	Photo Voltaic, 28 nA, 1K = 5.6 µA	2.90	2.40	2.10
BPY11P-6	Photo Voltaic, 28 nA, 1K = 7.1 µA	3.10	2.60	2.30
BPY47	Photo Voltaic, .9 µA	13.00	10.00	9.00
BPY48	Photo Voltaic, .3 µA	9.60	7.70	6.70
BPY61-1	Photo Xtr, Sub Min, 10°, .64 mA	6.00	4.90	4.45
BPY61-2	Photo Xtr, Sub Min, 10°, 1.0 mA	6.10	5.20	4.60
BPY61-3	Photo Xtr, Sub Min, 10°, 1.6 mA	6.70	5.35	4.80
BPY61-4	Photo Xtr, Sub Min, 10°, 2.56 mA	6.90	5.50	4.90
BPY62-1	Photo Xtr, T0-18, 6°, 1.0 mA	1.05	.90	.80
BPY62-2	Photo Xtr, T0-18, 6°, 1.6 mA	1.10	1.00	.90
BPY62-3	Photo Xtr, T0-18, 6°, 2.56 mA	1.25	1.15	1.00
BPY64	Photo Voltaic, .16 µA	5.20	4.40	4.10
CNY17-1	Isolator, Sngl., 40% Ctr, 4000 V	1.90	1.70	1.55
CNY17-2	Isolator, Sngl., 63% Ctr, 4000 V	2.10	1.85	1.70
CNY17-3	Isolator, Sngl., 100% Ctr, 4000 V	2.25	2.00	1.85
CNY17-4	Isolator, Sngl., 160% Ctr, 4000 V	2.40	2.20	1.95
CNY18-1	Isolator, T0-72, 10% Ctr, 800 V	3.40	2.85	2.50
CNY18-2	Isolator, T0-72, 16% Ctr, 800 V	3.60	3.00	2.65
CNY18-3	Isolator, T0-72, 25% Ctr, 800 V	3.80	3.20	2.80
CNY18-4	Isolator, T0-72, 40% Ctr, 800 V	4.00	3.30	2.95
CQX13-1	Lamp, Green, Low T1½, 2.5 mcd, 20 mA	.62	.49	.40
CQX13-2	Lamp, Green, Low T1½, 5.0 mcd, 20 mA	.95	.70	.60
CQX23-1	Lamp, Red, Low T1½, 2.0 mcd, 20 mA	.62	.49	.40
CQX23-2	Lamp, Red, Low T1½, 3.2 mcd, 20 mA	.95	.70	.60
CQX33-1	Lamp, Yellow, Low T1½, 1.6 mcd, 20 mA	.62	.49	.40
CQX33-2	Lamp, Yellow, Low T1½, 2.5 mcd, 20 mA	.95	.70	.60
CQY17-4	Lamp, Infrared, T0-18, 13°, 1.1 mW	1.70	1.35	1.20
CQY17-5	Lamp, Infrared, T0-18, 13°, 1.8 mW	2.15	1.70	1.50
CQY77-1	Lamp, Infrared, T0-18, 6°, 8 mW	1.55	1.20	1.05
CQY77-2	Lamp, Infrared, T0-18, 6°, 12.5 mW	1.60	1.25	1.10
CQY77-3	Lamp, Infrared, T0-18, 6°, 20 mW	2.35	1.90	1.65
CQY78-1	Lamp, Infrared, T0-18, 40°, 1.0 mW	1.55	1.20	1.05
CQY78-2	Lamp, Infrared, T0-18, 40°, 1.6 mW	1.60	1.25	1.10
CQY78-3	Lamp, Infrared, T0-18, 40°, 2.5 mW	2.35	1.90	1.65
DL-10	Display, Red, .27" C.A., D.P. Left	9.00	7.50	6.30
DL-10A	Display, Red, .27" C.A., D.P. Left	6.30	5.25	4.65
DL-34M	Display, Red, .11" C.C. MPX, 4 Digit	9.15	7.55	6.30
DL-44M	Display, Red, .15" C.C. MPX, 2 Digit	7.10	5.85	4.90
DL-57	Display, Red, .35" 5 x 7 Dot Matrix	10.98	7.32	6.10
DL-101	Display, Red, .27" C.A. ±1 Overflow	9.00	7.50	6.30
DL-101A	Display, Red, .27" C.A. ±1 Overflow	6.30	5.25	4.65
DL-304	Display, Red, .30" C.C., D.P. Left	1.35	1.10	.90
DL-307	Display, Red, .30" C.A., D.P. Left	1.35	1.10	.90
DL-330M	Display, Red, .11" C.C. MPX, 3 Digit	6.20	4.70	4.10
DL-340M	Display, Red, .11" C.C. MPX, 4 Digit	8.25	6.40	5.50
DL-416	Display, Red, .16" 16 Seg Alpha, 4 Digit	18.00	12.00	10.00
DL-430M	Display, Red, .15" C.C. MPX, 3 Digit	8.75	6.60	5.70
DL-440M	Display, Red, .15" C.C. MPX, 2 Digit	6.00	4.50	3.90
DL-500	Display, Red, .50" C.C., D.P. Right	1.45	1.15	.95
DL-507	Display, Red, .50" C.A., D.P. Right	1.45	1.15	.95
DL-521	Display, Red, .50" C.A. ± Overflow	3.90	3.00	2.50
DL-522	Display, Red, .50" C.C. ± Overflow	3.90	3.00	2.50
DL-527	Display, Red, .50" C.A., D.P. Right	3.90	3.00	2.50
DL-528	Display, Red, .50" C.C., D.P. Right	3.90	3.00	2.50
DL-701	Display, Red, 0.3" C.A. ± Overflow	2.34	1.80	1.50
DL-702	Display, Red, 0.3" C.C., D.P. Left	2.34	1.80	1.50
DL-704	Display, Red, 0.3" C.C., D.P. Right	2.34	1.80	1.50
DL-707	Display, Red, 0.3" C.A., D.P. Left	2.34	1.80	1.50
DL-707R	Display, Red, 0.3" C.A., D.P. Right	2.34	1.80	1.50
DL-721	Display, Red, .51" C.A. ±1 Overflow	5.00	3.80	3.20
DL-722	Display, Red, .51" C.C. ±1 Overflow	5.00	3.80	3.20
DL-727	Display, Red, .51" C.A., D.P. Right	5.00	3.80	3.20
DL-728	Display, Red, .51" C.C., D.P. Right	5.00	3.80	3.20
DL-746	Display, Red, .63" C.A. ±1 Overflow	4.00	3.10	2.55
DL-747	Display, Red, .63" C.A. D.P. Left	4.00	3.10	2.55
DL-749	Display, Red, .63" C.C. ±1 Overflow	4.00	3.10	2.55
DL-750	Display, Red, .63" C.C. D.P. Left	4.00	3.10	2.55
DL-846	Display, Red, .80" C.A. ±1 Overflow	2.70	2.05	1.75
DL-847	Display, Red, .80" C.A., D.P. Left	2.70	2.05	1.75
DL-850	Display, Red, .80" C.C., D.P. Left	2.70	2.05	1.75

Part Number	Description	1-9	10-99	100-999	1000
DL-1414	Display, Red, .112", Intelligent, 4 Digit	21.00	17.50	15.00	13.00
DL-1416	Display, Red, .160", Intelligent, 4 Digit	30.00	25.00	22.50	18.75
DL-2416	Display, Red, .160", Intelligent, 4 Digit	42.00	35.00	30.00	26.00

Part Number	Description	1-99	100-999	1000
DL-2130	Display, Red, 1.0" C.A. MPX, 2 Digit	7.20	5.60	4.60
DL-3130	Display, Red, 1.0" C.A. MPX, 3 Digit	10.80	8.40	6.90
DL-3531	Display, Red, .50" C.A. MPX, 3 1/2 Digit	7.80	6.00	5.00
DL-4120A	Display, Red, 1.0" C.C. NMPX, 4 Digit	14.40	11.20	9.20
DL-4130	Display, Red, 1.0" C.A. MPX, 4 Digit	14.40	11.20	9.20
DL-4500	Display, Red, .50" C.C. MPX, 4 Digit	7.80	6.00	5.00
DL-4507	Display, Red, .50" C.C. MPX, 4 Digit	6.50	4.50	3.05
DL-4509	Display, Red, .50" C.C. MPX, 4 Digit	7.00	5.00	4.50
DL-4520A	Display, Red, .50" C.C. NMPX, 4 Digit	7.80	6.00	5.00
DL-4530	Display, Red, .50" C.A. MPX, 4 Digit	7.80	6.00	5.00
DL-6500	Display, Red, .50" C.C. MPX, 6 Digit	11.70	9.00	7.50
DL-6830	Display, Red, .80" C.A. MPX, 6 Digit	16.20	12.30	10.50
DL-7750	Display, Red, .43" C.A., D.P. Left	1.85	1.60	1.30
DL-7751	Display, Red, .43" C.A., D.P. Right	1.85	1.60	1.30
DL-7756	Display, Red, .43" Univ. ± 1 Overflow	1.85	1.60	1.30
DL-7760	Display, Red, .43" C.C., D.P. Right	1.85	1.60	1.30
DLG-304	Display, Green, .30" C.C., D.P. Left	2.95	2.10	1.80
DLG-307	Display, Green, .30" C.A., D.P. Left	2.95	2.10	1.80
DLG-500	Display, Green, .50" C.C., D.P. Right	3.15	2.20	1.90
DLG-507	Display, Green, .50" C.A., D.P. Right	3.15	2.20	1.90
DLG-521	Display, Green, .50" C.A. ± 1 Overflow	6.50	4.50	3.90
DLG-522	Display, Green, .50" C.C. ± 1 Overflow	6.50	4.50	3.90
DLG-527	Display, Green, .50" C.A., D.P. Right	6.50	4.50	3.90
DLG-528	Display, Green, .50" C.C., D.P. Right	6.50	4.50	3.90
DLG-846	Display, Green, .80" C.A. ± 1 Overflow	4.40	3.10	2.65
DLG-847	Display, Green, .80" C.A., D.P. Left	4.40	3.10	2.65
DLG-850	Display, Green, .80" C.C., D.P. Left	4.40	3.10	2.65
DLG-7670	Display, Green, .43" C.A., D.P. Left	2.90	2.30	1.95
DLG-7671	Display, Green, .43" C.A., D.P. Right	2.90	2.30	1.95
DLG-7673	Display, Green, .43" C.C., D.P. Right	2.90	2.30	1.95
DLG-7676	Display, Green, .43" Univ. ± 1 Overflow	2.90	2.30	1.95
DLO-304	Display, Brite Red, .30" C.C., D.P. Left	2.95	2.10	1.80
DLO-307	Display, Brite Red, .30" C.A., D.P. Left	2.95	2.10	1.80
DLO-500	Display, Brite Red	3.15	2.20	1.90
DLO-507	Display, Brite Red	3.15	2.20	1.90
DLO-521	Display, Brite Red, .50" C.A. ± 1 Overflow	6.50	4.50	3.90
DLO-522	Display, Brite Red, .50" C.C. ± 1 Overflow	6.50	4.50	3.90
DLO-527	Display, Brite Red, .50" C.A., D.P. Right	6.50	4.50	3.90
DLO-528	Display, Brite Red, .50" C.C., D.P. Right	6.50	4.50	3.90
DLO-846	Display, Brite Red, .80" C.A. ± 1 Overflow	4.40	3.10	2.65
DLO-847	Display, Brite Red, .80" C.A., D.P. Left	4.40	3.10	2.65
DLO-850	Display, Brite Red, .80" C.C., D.P. Left	4.40	3.10	2.65
DLO-7650	Display, Brite Red, .43" C.A., D.P. Left	2.90	2.30	1.95
DLO-7651	Display, Brite Red, .43" C.A., D.P. Right	2.90	2.30	1.95
DLO-7653	Display, Brite Red, .43" C.C., D.P. Right	2.90	2.30	1.95
DLO-7656	Display, Brite Red, .43" Univ. ± 1 Overflow	2.90	2.30	1.95
DLY-304	Display, Yellow, .30" C.C., D.P. Left	2.95	2.10	1.80
DLY-307	Display, Yellow, .30" C.A., D.P. Left	2.95	2.10	1.80
DLY-500	Display, Yellow, .50" C.C., D.P. Right	3.15	2.20	1.90
DLY-507	Display, Yellow, .50" C.A., D.P. Right	3.15	2.20	1.90
DLY-521	Display, Yellow, .50" C.A. ± 1 Overflow	6.50	4.50	3.90
DLY-522	Display, Yellow, .50" C.C. ± 1 Overflow	6.50	4.50	3.90
DLY-527	Display, Yellow, .50" C.A., D.P. Right	6.50	4.50	3.90
DLY-528	Display, Yellow, .50" C.C., D.P. Right	6.50	4.50	3.90
DLY-846	Display, Yellow, .80" C.A. ± 1 Overflow	4.40	3.10	2.65
DLY-847	Display, Yellow, .80" C.A., D.P. Left	4.40	3.10	2.65
DLY-850	Display, Yellow, .80" C.C., D.P. Left	4.40	3.10	2.65
DLY-7660	Display, Yellow, .43" C.A., D.P. Left	2.90	2.30	1.95
DLY-7661	Display, Yellow, .43" C.A., D.P. Right	2.90	2.30	1.95
DLY-7663	Display, Yellow, .43" C.C., D.P. Right	2.90	2.30	1.95
DLY-7666	Display, Yellow, .43" Univ. ± 1 Overflow	2.90	2.30	1.95
FRL-4403	Lamp, Red, T1 1/4, Flashing	.92	.71	.59
GL 56	Lamp, Green, Min. Axial	.47	.32	.28
GL 211	Lamp, Green, T1, .8 mcd, 20 mA	.28	.24	.19
GL 4484	Lamp, Green, T1, No Min. mcd	.25	.20	.17
GL 4850	Lamp, Green, T1 1/4, No Min. mcd	.40	.28	.24
GL 4950	Lamp, Green, T1 1/4, 1.0 mcd, 20 mA	.55	.37	.30

Part Number	Description	1-99	100-999	1000
IL-1	Isolator, Sngl., 20% Ctr, 2500 V	.99	.69	.60
IL-5	Isolator, Sngl., 50% Ctr, 2500 V	1.20	.83	.72
IL-12	Isolator, Sngl., 10% Ctr, 1000 V	.82	.57	.49
IL-15	Isolator, Sngl., 6% Ctr, 1500 V	.90	.63	.54
IL-16	Isolator, Sngl., .06% Ctr, 1000 V	1.04	.72	.62
IL-74	Isolator, Sngl., 125% Ctr, 1500 V	.93	.65	.56
IL-100	Isolator, Sngl., Hi-Speed, 65 ns	5.26	4.50	3.75
IL-101	Isolator, Sngl., Hi-Speed, 100 ns	3.60	2.80	2.40
ILA30	Isolator, Sngl., 100% Ctr, 1500 V	1.25	.86	.75
ILA55	Isolator, Sngl., 100% Ctr, 1500 V	1.42	.99	.85
ILCA2-30	Isolator, Sngl., 100% Ctr, 1500 V	1.35	.95	.82
ILCA2-55	Isolator, Sngl., 100% Ctr, 1500 V	1.50	1.05	.90
ILCT6	Isolator, Dual, 20% Ctr, 1500 V	2.08	1.44	1.25
ILD74	Isolator, Dual, 20% Ctr, 1500 V	1.90	1.30	1.14
ILQ74	Isolator, Quad, 12.5% Ctr, 1500 V	4.00	2.77	2.40
IRL-55	Lamp, Infrared, Narrow Beam	.86	.65	.56
IRL-60	Lamp, Infrared, Wide Beam	.84	.58	.50
IRL-61	Lamp, Infrared, Stud Pkg.	.86	.65	.56
LD32-1	Lamp, Red, T1, 1.2 mcd, 10 mA	.45	.30	.25
LD32-2	Lamp, Red, T1, 2.0 mcd, 10 mA	.54	.42	.35
LD36-2	Lamp, Yellow, T1, 1.6 mcd, 10 mA	.54	.42	.35
LD36C	Lamp, Yellow, T1, 2.0 mcd, 10 mA	.57	.45	.38
LD37-1	Lamp, Green, T1, 2.0 mcd, 20 mA	.45	.30	.25
LD37-2	Lamp, Green, T1, 3.2 mcd, 20 mA	.50	.42	.35
LD37C	Lamp, Green, T1, 4.0 mcd, 20 mA	.45	.30	.25
LD52-1	Lamp, Red, T1 1/4, 1.2 mcd, 10 mA	.50	.35	.30
LD52-2	Lamp, Red, T1 1/4, 2.0 mcd, 10 mA	.54	.42	.35
LD52C	Lamp, Red, T1 1/4, 15 mcd, 10 mA	.75	.55	.45
LD52CA	Lamp, Red, T1 1/4, 9 mcd, 10 mA	.60	.45	.38
LD56-2	Lamp, Yellow, T1 1/4, 1.6 mcd, 10 mA	.54	.42	.35
LD56C	Lamp, Yellow, T1 1/4, 10 mcd, 10 mA	.75	.55	.45
LD56CA	Lamp, Yellow, T1 1/4, 6 mcd, 10 mA	.60	.45	.38
LD57-1	Lamp, Green, T1 1/4, 2.0 mcd, 20 mA	.45	.30	.25
LD57-2	Lamp, Green, T1 1/4, 3.2 mcd, 20 mA	.50	.42	.35
LD57C	Lamp, Green, T1 1/4, 20 mcd, 10 mA	.75	.55	.45
LD57CA	Lamp, Green, T1 1/4, 12 mcd, 10 mA	.60	.45	.38
LD121	Lamp, Red, Ultra Min, .5 mcd, 10 mA	.90	.69	.60
LD161	Lamp, Yellow, Ultra Min, .8 mcd, 10 mA	.90	.69	.60
LD171	Lamp, Green, Ultra Min, .4 mcd, 10 mA	.90	.69	.60
LD242-1	Lamp, Infrared, Mod T0-18, 60°, 2.5 mW	1.25	1.00	.88
LD242-2	Lamp, Infrared, Mod T0-18, 60°, 4.0 mW	1.30	1.15	.95
LD242-3	Lamp, Infrared, Mod T0-18, 60°, 8.0 mW	1.50	1.30	1.10
LD260	Lamp, Infrared, Array, 10 Diode	17.00	13.50	11.00
LD261-4	Lamp, Infrared, Min Radial, 30°, 2.0 mW	1.10	.80	.65
LD261-5	Lamp, Infrared, Min Radial, 30°, 3.2 mW	1.20	.90	.72
LD261-6	Lamp, Infrared, Min Radial, 30°, 5.0 mW	1.30	.97	.78
LD262	Lamp, Infrared, Array, 2 Diode	3.70	3.00	2.40
LD263	Lamp, Infrared, Array, 3 Diode	5.00	4.05	3.30
LD264	Lamp, Infrared, Array, 4 Diode	7.00	5.70	4.60
LD265	Lamp, Infrared, Array, 5 Diode	9.00	7.30	5.90
LD266	Lamp, Infrared, Array, 6 Diode	10.00	8.20	6.60
LD267	Lamp, Infrared, Array, 7 Diode	12.50	10.00	8.20
LD268	Lamp, Infrared, Array, 8 Diode	14.00	11.50	9.20
LD269	Lamp, Infrared, Array, 9 Diode	15.50	12.50	10.00
LD271	Lamp, Infrared, Mod T0-18, 30°, 15 mW	.65	.54	.48
LD460	Lamp, Red, Array, 10 Diode	4.10	2.95	2.70
LD461	Lamp, Red, Sub Min, .6 mcd, 20 mA	.34	.27	.23
LD461A	Lamp, Red, Sub Min, .4 mcd, 20 mA	.28	.22	.17
LD462	Lamp, Red, Array, 2 Diode	.68	.52	.46
LD463	Lamp, Red, Array, 3 Diode	1.05	.77	.70
LD464	Lamp, Red, Array, 4 Diode	1.35	1.02	.93
LD465	Lamp, Red, Array, 5 Diode	1.80	1.29	1.17
LD466	Lamp, Red, Array, 6 Diode	2.30	1.68	1.52
LD467	Lamp, Red, Array, 7 Diode	2.70	1.94	1.76
LD468	Lamp, Red, Array, 8 Diode	3.00	2.23	2.00
LD469	Lamp, Red, Array, 9 Diode	3.70	2.70	2.45
LD470	Lamp, Green, Array, 10 Diode	4.70	3.50	3.10
LD471	Lamp, Green, Sub Min, 3.2 mcd, 20 mA	.42	.31	.28
LD471A	Lamp, Green, Sub Min, 1.2 mcd, 20 mA	.34	.24	.22
LD472	Lamp, Green, Array, 2 Diode	.94	.68	.60
LD473	Lamp, Green, Array, 3 Diode	1.35	1.00	.88
LD474	Lamp, Green, Array, 4 Diode	1.80	1.35	1.20
LD475	Lamp, Green, Array, 5 Diode	2.30	1.70	1.50
LD476	Lamp, Green, Array, 6 Diode	2.70	2.10	1.85
LD477	Lamp, Green, Array, 7 Diode	3.40	2.50	2.20
LD478	Lamp, Green, Array, 8 Diode	3.70	2.90	2.50
LD479	Lamp, Green, Array, 9 Diode	4.40	3.15	2.80

Part Number	Description	1-99	100-999	1000
LPT100	Phototransistor, Ceramic, 30°, .3 mA	.80	.60	.50
LPT100A	Phototransistor, Ceramic, 30°, 1.0 mA	.95	.70	.62
LPT100B	Phototransistor, Ceramic, 30°, 1.3 mA	1.15	.85	.75
LPT110	Phototransistor, Ceramic, 50°, .2 mA	.73	.55	.51
LPT110A	Phototransistor, Ceramic, 50°, .6 mA	.99	.76	.64
LPT110B	Phototransistor, Ceramic, 50°, .8 mA	1.29	.94	.77
OL30	Lamp, Orange, T1½, .8 mcd, 20 mA	.36	.25	.21
OL31	Lamp, Orange, T1, .3 mcd, 20 mA	.25	.17	.15
RBG1000	Display, 10 Element Bar Graph	3.30	2.30	1.95
RL2	Lamp, Red, Compact, Diffused	.50	.37	.32
RL2-02	Lamp, Red, Compact, Red, Clear	.50	.37	.32
RL2-03	Lamp, Red, Compact, White, Diffused	.50	.37	.32
RL2-04	Lamp, Red, Compact, Water, Clear	.50	.37	.32
RL20	Lamp, Red, T1¼, Diffused, .8 mcd	.40	.28	.24
RL20-02	Lamp, Red, T1¼, Red, Clear	.40	.28	.24
RL20-03	Lamp, Red, T1¼, White, Diffused	.40	.28	.24
RL20-04	Lamp, Red, T1¼, Water, Clear	.40	.28	.24
RL21	Lamp, Red, T1¼, Diffused, Wide	.36	.25	.21
RL21-02	Lamp, Red, T1¼, Red, Clear	.36	.25	.21
RL21-03	Lamp, Red, T1¼, White, Diffused	.36	.25	.21
RL21-04	Lamp, Red, T1¼, Water, Clear	.36	.25	.21
RL50	Lamp, Red, Sub Min, Water, Clear	.26	.19	.15
RL50-01	Lamp, Red, Sub Min, Red, Diffused	.26	.19	.15
RL50-02	Lamp, Red, Sub Min, Red, Clear	.26	.19	.15
RL50-03	Lamp, Red, Sub Min, White, Diffused	.26	.19	.15
RL54	Lamp, Red, Sub Min, No Min mcd	.21	.17	.14
RL55	Lamp, Red, Sub Min, 2.0 mcd, 20 mA	.33	.23	.20
RL55-5	Lamp, Red, Sub Min, 0.8 mcd, 20 mA	.21	.17	.14
RL209	Lamp, Red, T1, .075" Leads, .3 mcd	.21	.17	.14
RL209A	Lamp, Red, T1, .075" Leads, .5 mcd	.21	.17	.14
RL209-1	Lamp, Red, T1, .075" Leads, 1.0 mcd	.28	.20	.17
RL209-2	Lamp, Red, T1, .075" Leads, 2.0 mcd	.33	.23	.20
RL209-02	Lamp, Red, T1, Red, Clear	.26	.19	.16
RL209-03	Lamp, Red, T1, White, Diffused	.26	.19	.16
RL209-04	Lamp, Red, T1, Water, Clear	.26	.19	.16
RL2000	Lamp, Red, T1¼, 2.0 mcd, 20 mA	.40	.28	.24
RL4403	Lamp, Red, T1¼, 0.8 mcd, 20 mA	.36	.25	.21
RL4415	Lamp, Red, T1¼, Right Angle Leads	.40	.28	.24
RL4480	Lamp, Red, T1, .100 Leads, .3 mcd	.30	.23	.19
RL4480-1	Lamp, Red, T1, .100 Leads, 1.0 mcd	.36	.25	.21
RL4480-2	Lamp, Red, T1, .100 Leads, 2.0 mcd	.46	.32	.28
RL4480-5	Lamp, Red, T1, .100 Leads, No Min mcd	.21	.15	.13
RL4484	Lamp, Red, T1, .075 Leads, No Min mcd	.21	.15	.13
RL4850	Lamp, Red, T1¼, No Min mcd	.21	.15	.13
RL5054-1	Lamp, Red, T1¼, 1.0 mcd, 10 mA	.28	.20	.17
RL5054-2	Lamp, Red, T1¼, 2.0 mcd, 10 mA	.33	.23	.20
RL5054-5	Lamp, Red, T1¼, .5 mcd, 10 mA	.21	.15	.13
RLC200	Lamp, Red, T1¼, Constant Current, 20 mA	.54	.42	.35
RLC201	Lamp, Red, T1¼, Constant Current, 10 mA	.54	.42	.35
RLC210	Lamp, Red, T1, Constant Current, 10 mA	.50	.37	.32
RLC410	Lamp, Red, T1, Voltage Indicator	.90	.60	.50
RLT1	Lamp, Red, T1, Flangeless, Diffused	.26	.19	.16
RLT1-02	Lamp, Red, T1, Flangeless, Red, Clear	.26	.19	.16
RLT1-03	Lamp, Red, T1, Flangeless, White, Diffused	.26	.19	.16
RLT1-04	Lamp, Red, T1, Flangeless, Water, Clear	.26	.19	.16
□TP60	Photo Voltaic Cell, .7 µA	15.00	12.00	10.50
□TP61	Photo Voltaic Cell, .7 µA	10.25	8.10	7.10
YL56	Lamp, Yellow, Sub Min, Axial	.47	.32	.28
YL212	Lamp, Yellow, T1, 1.0 mcd, 10 mA	.33	.23	.20
YL4484	Lamp, Yellow, T1, No Min mcd	.31	.21	.18
YL4550	Lamp, Yellow, T1¼, 1.0 mcd, 10 mA	.55	.37	.30
YL4850	Lamp, Yellow, T1¼, No Min mcd	.40	.28	.24

▲New Product

●New Product available 2nd quarter 1979

□Not carried in stock.

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DISPLAYING MESSAGE SYSTEMS WITHOUT A MICROPROCESSOR

by Dave Takagishi

The DL-1416, 4 digit 16 segment, alphanumeric "Intelligent" display, and succeeding products in the family, have on board memory, decoder and drive circuitry. This makes it particularly well suited to marry directly to a microprocessor. However, small multi-message systems of 4, 8, 12, 16 character length need not have a microprocessor to drive the Alpha-Numeric Display. The DL-1416 with the aid of PROM can combine lighted indicators, status displays, annunciator messages or symbols, or a "canned message" into a single display.

ANNUNCIATOR DISPLAYS

An automobile, for example, has several switches each lighting its own status or annunciator indicator. A single DL-1416 Alphanumeric Display could easily display messages alternately upon interrogation of the appropriate switches.

The circuit shown in Figure 1 will display four character messages sequentially for each open switch and continue to display until switches are returned to their normally closed positions. The Counters U4 and U5 address the PROM U6 and select switches on U1. The Data Selector, U1, sequentially selects one of eight switches (oil, temperature, catalytic, generator, brake, door, belt, and null). The eighth switch or null state can display a blank for a normal or off condition. The output of U1 enables the DL-1416, $\overline{CE}$. When this signal goes high, the Monostable, U2, will fire and inhibit the Oscillator U3 for approximately a two second display time. The PROM, U6, generates the ASCII code data for each word. Expansion of the display can easily be achieved by adding a PROM for each additional DL-1416.

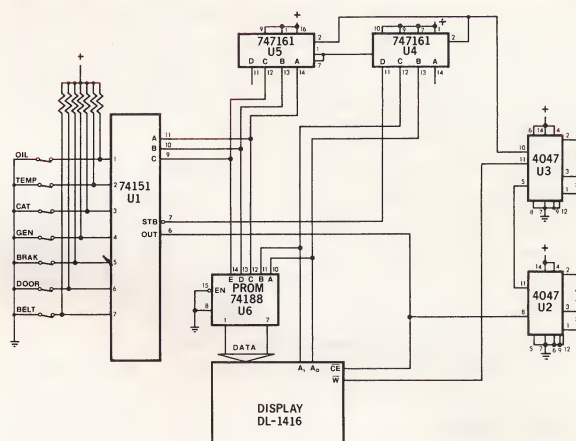


FIGURE 1

Another annunciator type display is shown in Figure 2. This display has a message of up to 16 characters and will continue to display the same line until the 6 bit input code changes state. With this scheme, it can be seen that the 16 character X64 line message PROM can easily be adapted for other message and character length combinations.

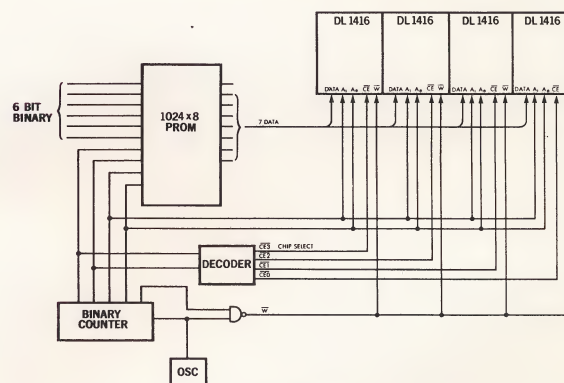


FIGURE 2
TYPICAL CIRCUIT FOR
64 MESSAGES OF 16 CHARACTERS LONG

CANNED MESSAGES

The canned message type display can be an ideal sales, marketing or instructional aid. The message can be altered by replacing the PROM.

The technique for this display would be to sequentially display a word or group of words, depending on the character length of the display, through the entire message. The system could either continue to repeat itself or could go through the complete sequence once each time a switch is operated.

Figure 3 is the schematic for a sales demo box for the DL-1416. A 256X8 PROM was used to display an 8 digit-32 word message. The oscillator, U1, increments the counters U2U3U4 providing the address for the DL1416's and PROM U9. After eight counts the monostable U10 is fired, inhibiting the oscillator for a two second display time. Devices U5 and U8 were added for cursor control. Decoder U8 will alternately enable or disable a data bit for a cursor to proceed writing new data into each digit. The multiplexer U5 will select the character data or the cursor data for the D0-D3 data lines. Inverters on the address lines cause data to occur from the left rather than from the right.

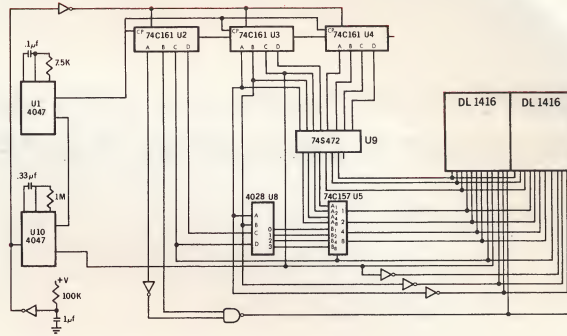


FIGURE 3

Seq 79

APPLYING THE DL-1416

by Dave Takagishi

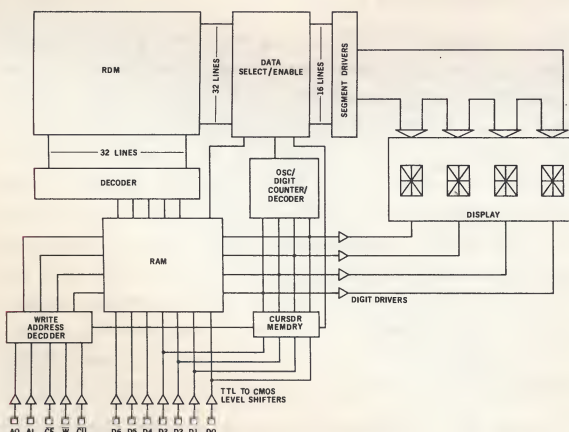
This application note is intended to serve as design and application guide for users of the DL-1416 Alphanumeric Display. The information presented covers: device electrical description and operation, considerations for general circuit designs, multi-digit display systems and interfacing to the 6800, Z80, and 8080 microprocessors.

The DL-1416 was designed to provide an easy-to-use alphanumeric display for the 64 character ASCII systems. Only twelve interconnect pins plus power and ground are needed to drive a single four digit display. The overall package is designed to allow end stacking of the DL-1416 to form any desired character length display.

ELECTRICAL DESCRIPTION

The on-board electronics of the DL-1416 eliminates all the traditional difficulties of using displays—segment decoding, driving, and multiplexing. The DL-1416 has gone further and provided internal memory for the four digits. This approach allows the user to address one of four digits, load the desired data asynchronously to the multiplex rate and continue.

Figure 1 is a block diagram of the circuitry in the DL-1416. The unit consists of a display and a single integrated circuit chip. The display is four 16-segment alphanumeric monolithic LED die magnified to a height of 160 mils. The IC chip contains the 16 segment drivers, 4 digit drivers, 64-character ROM, four-word 7-bit RAM, internal oscillator for multiplexing, multiplex counter/decoder, cursor RAM, write address decoder, and level shifters for the inputs.



INTERNAL SCHEMATIC
FIGURE 1

The inputs to the DL-1416 are:

- $\overline{CE}$ CHIP ENABLE (active low)**
This determines which device in an array will actually execute the loading of data. When the chip enable is in the high state, all inputs are inhibited.
- A_0, A_1 DIGIT ADDRESS**
The address to the DL-1416 determines the digit in which the data will be written. Address order is right-to-left for positive-true address.
- $D_0 - D_6$ DATA LINES**
The seven data input lines are designed to accept the 64 ASCII code set. See Table 1 for character set.
- $\overline{W}$ WRITE (active low)**
Data to be written into the DL-1416 must be present before the leading edge of write. The data and address must be stable until after the trailing edge.
- $\overline{CU}$ CURSOR (active low)**
When the $\overline{CU}$ is held low, the DL-1416 enables the user to write or remove a cursor in any digit position. The cursor function lights all 16 segments in the selected digits without erasing the data. After the cursor is removed, the digit will again display the previously written character.
- $V+$ POSITIVE SUPPLY**
TTL compatible + 5 volts
- $V-$ NEGATIVE SUPPLY**
Ground

CHARACTER SET

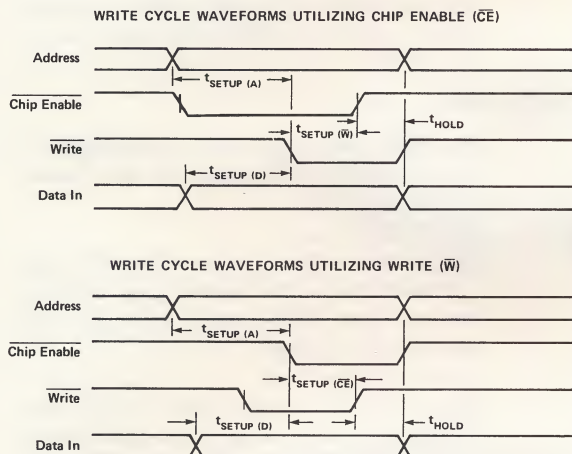
	D0	L	H	L	H	L	H	L	H
D1	L	L	H	H	L	L	H	H	
D2	L	L	L	L	H	H	H	H	
D6 D5 D4 D3									
L H L L		.	"	8	9	%	2	'	
L H L H		<	>	*	+	/	-	-	/
L H H L		0	1	2	3	4	5	6	7
L H H H		8	9	:	:	/	=	=	7
H L L L		a	A	B	C	D	E	F	G
H L L H		H	I	J	K	L	M	N	O
H L H L		P	Q	R	S	T	U	V	W
H L H H		X	Y	Z	[	\	]	^	_

TABLE 1

OPERATION

Loading data into the DL-1416 is similar to writing into a RAM. The data and address must be present before the leading edge of the write signal ($\overline{W}$) and must be present until after the trailing edge. The waveforms of Figure 2 demonstrate the relationship of the signals required to generate a write cycle utilizing chip enable ($\overline{CE}$) and write ($\overline{W}$) (Check data sheet for minimum values).

As can be seen from the waveforms, $\overline{CE}$ and $\overline{W}$ are interchangeable. The true internal "write" function is formed by the "and-of-the-nots".



ADDRESS TABLE
FIGURE 2

Multiplexed display systems sequentially read and display data from a memory device. In *synchronous* systems, control circuitry must compare the location of data to be read and displayed to the location of new data to be stored, i.e. synchronize, before a write can be done. This can be slow if there are many memory locations. It can also be cumbersome.

Data entry of the DL-1416 is *asynchronous* and data may be stored in random order. Each digit will continue to display the character last "written" until replaced by another.

The cursor function causes all 16 segments of a digit to light. The cursor can indicate the position in the display of the next character to be entered. The cursor *is not* a character but overrides display of the stored character. Upon removal of the cursor, the display will again show the character stored in memory.

The cursor can be written into any digit position by enabling chip enable ($\overline{CE}$), cursor ($\overline{CU}$), the positional data, and a write ($\overline{W}$) signal. The position of the cursor will be dependent on which of the first four data lines (D_0 , D_1 , D_2 , D_3) are held high. A high on data line D_0 will place a cursor display in the right-most digit and respectively a high on data

line D_3 will place a cursor display in the left-most digit. The cursor can be loaded into, or erased from more than one position simultaneously by simply holding more than one data line high during the cursor write cycle.



CURSOR WRITE CYCLE
FIGURE 3

The cursor will remain displayed after the cursor ($\overline{CU}$) and write ($\overline{W}$) signals have been removed. The wave forms in Figure 3 show a cursor being placed in Digit 0 and erased from Digit 1, Digit 2, and Digit 3 simultaneously.

GENERAL CIRCUIT DESIGN CONSIDERATIONS

Using positive-true address logic, address order is from right to left. For left to right address order, use the "ones-complement" or simple inversion of the addresses.

For systems with only a 6 bit ASCII code format, data line D_6 cannot be left open. Data D_6 must be the complement of data line D_5 . If an illegal code is loaded into the DL-1416, it will display a blank in the digit accessed.

A "display test" function can be realized by simply storing a cursor in all digits simultaneously. This is done by holding D_0 , D_1 , D_2 and D_3 high and $\overline{CU}$ low during a cursor write cycle. The same operation, with the data lines low will end "display test".

Because of the random state of the cursor RAM after power up, it is necessary to clear it initially to assure that all the cursors are off.

When using DL-1416's on a separate display board having more than two feet of cable length, it may be necessary to buffer all DL-1416 inputs. This is most easily achieved with hex-non-inverting buffers such as 74365 IC's. The object is to prevent transient current in the DL-1416 protection diodes. The buffers should be located on the display board near the DL-1416's. Local power supply bypass capacitors are also needed in many cases. These should be 6 or 10 volt tantalum type having 10 μ F or greater capacitance. Low internal resistance is important to eliminate voltage transients due to the current steps which result from the internal multiplexing of the DL-1416.

If small wire cables are used, it is good engineering practice to calculate the wire resistance of the ground plus the +5 volt wires. More than 0.1 volt drop (at

25mA per digit worst case) should be avoided, since this loss is in addition to any inaccuracies or load regulation limitations of the power supply. limitations of the power supply.

GENERAL INTERFACE

The most general and straight-forward interface approach would be to use the parallel I/O device of a microprocessor. This interface scheme can be completely software dependent. One eight bit output port can handle the seven input data bits and the cursor. Another eight bit output port can contain the address and chip enable information with one bit reserved for the write signal.

An 8080 system shown in Figure 4 illustrates a 16 character display using a 8255 programmable peripheral interface I/O device with a 7442 one-of-ten decoder added for ease of programming. The following program will display a simple 16 character message using the parallel I/O interface.

INIT:	MVI A, 80H;	control data mode 0
	OUT CONTROL;	load control register
CUSR:	MVI A, 00H;	clear cursor data
	OUT PORTA;	load data port
	MVI B, 0FH;	set counter
CUSR1:	MOV A, B	
	CALL DSPWT;	write subroutine
	DCR B;	decrement counter
	JNZ CUSR1;	16 characters
		set table
DISP:	LXI H, TABLE;	
DISP1:	MOV A, M	
	OUT PORTA;	load data output
	MOV A, B	
	CALL DSPWT;	load address & write
	INX H;	increment table address
	INR B;	increment counter
	MVI A, 10H;	set # of digits
	CMP B	
	JNZ DISP1;	16 characters
	HLT;	end of program
DSPWT:	ORI 80H;	set write bit off
	OUT PORTB;	load address
	ANI 7FH;	set write bit on
	OUT PORTB;	load write
	ORI 80H;	set write bit off
	OUT PORTB;	load write
	RET	
TABLE:	DB	OC3H
	DB	OC9H
	DB	OD4H
	DB	OD3H
	DB	OC1H
	DB	OD4H
	DB	OCEH
	DB	OC1H
	DB	OC6H
	DB	OA0H
	DB	OD3H
	DB	OD4H
	DB	OC8H
	DB	OC7H
	DB	OC9H
	DB	OCCH

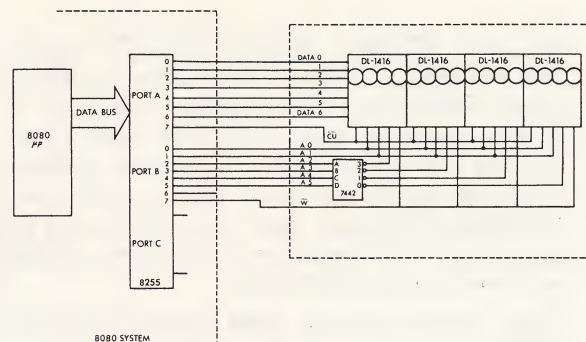


FIGURE 4

I/O OR MEMORY MAPPED ADDRESSING

Some designers may wish to avoid the additional cost of a parallel I/O device in their system. Structuring the addressing architecture for the DL-1416 to look like a set of output devices (I/O mapped) or RAM's, ROM's (memory mapped) is ideal. However, the set-up and hold times of the DL-1416 are too slow for some present μP 's running at maximum speed.

To operate at maximum clock rates, the processor must be made to pause for the required display write cycle interval.

DL 1416/8080 INTERFACE

Microprocessors like the 8080 and Z80 have the ability to generate "wait states" for use with relatively slow memories. Figure 5 shows a circuit which utilizes "wait states" to interface the DL-1416 display to an 8080 system with a T cycle = 500 nS.

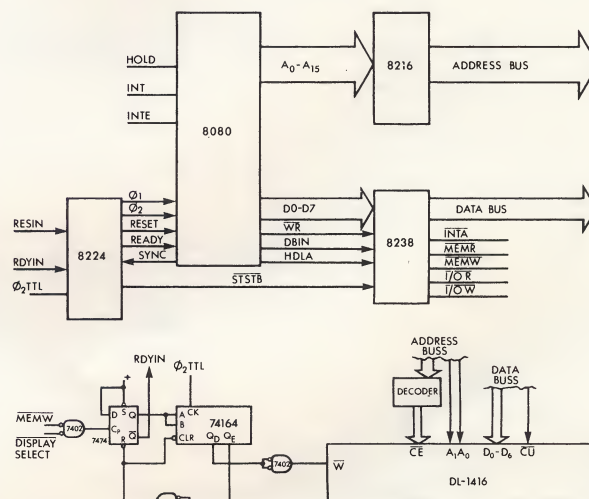


FIGURE 5

The signal $\overline{\text{MEMW}} \bullet \overline{\text{DISPLAY SELECT}}$ defines a DL-1416 display write cycle and initiates the RDYIN signal. $\overline{\text{MEMW}}$ alone would generate wait states for all write cycles and would slow down total computation. The shift register, 74164, is useful for generating a DL-1416 write signal which meets the setup times for different processor clock rates. The timing diagram, Figure 6, illustrates the relationship between write, wait, and DL-1416 write.

*Note: System controller 8238 required for an early MEMW signal.

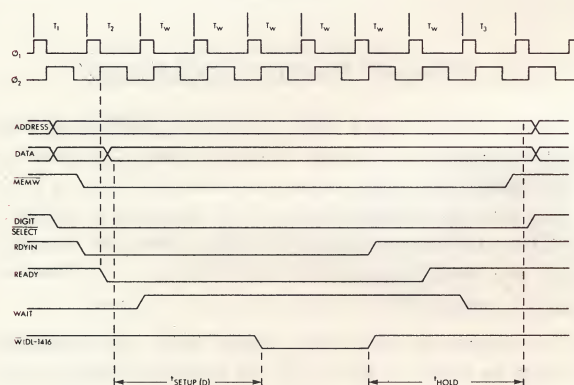


FIGURE 6

DL-1416/Z80 INTERFACE

The organization of the Z80 is very similar to the 8080 processor. Both processors utilize wait states for slow memory and, as can be seen in Figure 7, the interface can be identical to the 8080 System. For T cycle = 500 nS, only signal names are different.

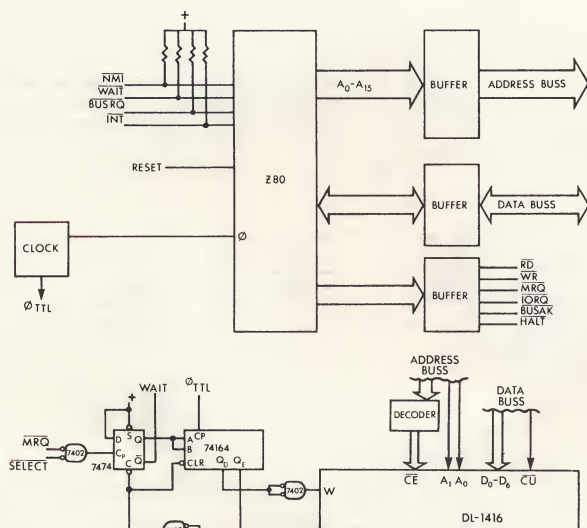


FIGURE 7

DL-1416/6800 Interface

For processors such as the 6800 that do not have wait state capability, clock pulse stretching techniques can be used. Microprocessor clocks such as the Motorola MC6871B have the ability to hold either $\phi 1$ or $\phi 2$. Figure 8 uses the same interface techniques as for the 8080 and Z80. The signal $\overline{\text{H2}}$ extends the $\phi 2$ clock. All address and data lines will remain valid until $\overline{\text{H2}}$ is released. $\overline{\text{H2}}$ was taken from the output of the first stage of the shift register in this case to synchronize with $\phi 2$; otherwise a narrow $\phi 1$ may result.

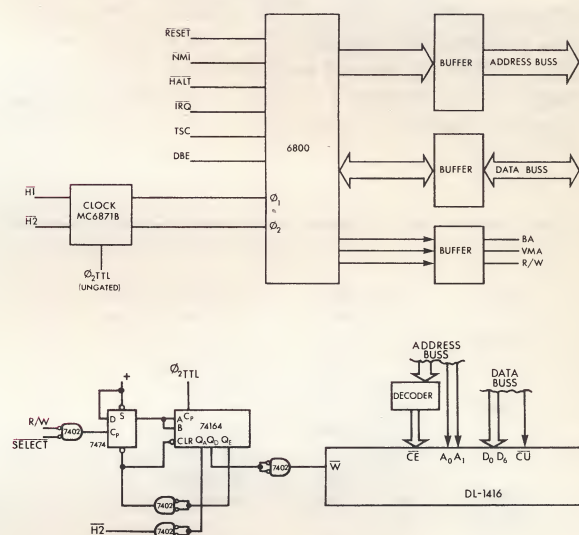


FIGURE 8

CONCLUSION

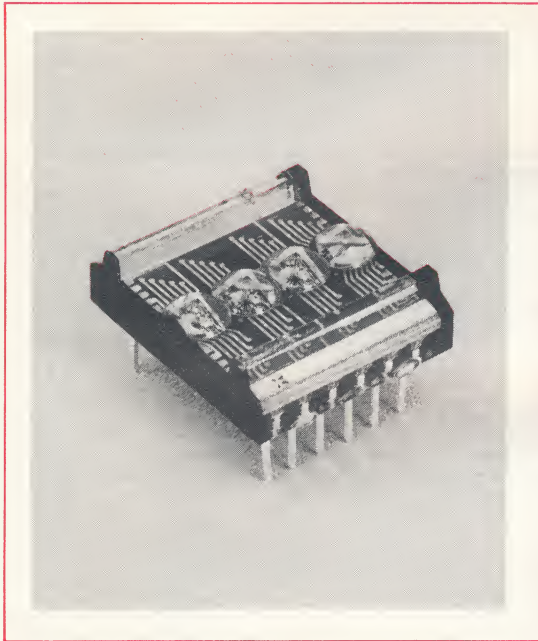
The interface schemes shown demonstrate the general simplicity of DL-1416 use with microprocessors. The differences among the examples are in providing proper write signals. Because of the setup and hold times of the DL-1416, many microprocessor systems will require some type of interface circuitry for compatibility. The techniques used in these examples were chosen for their versatility in accepting a wide range of clock rates. The user will undoubtedly invent other schemes to optimize his particular system to its requirements.

This application note is not intended to imply specific endorsement or warranty of other manufacturer's products by Litronix.

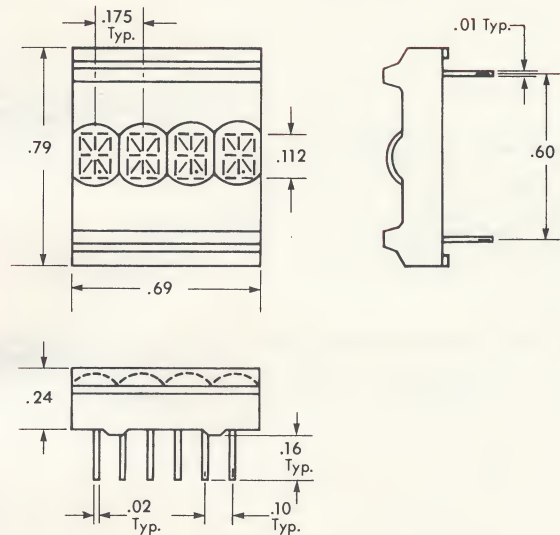
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DL-1414

4 DIGIT 17 SEGMENT ALPHANUMERIC Intelligent Display™ WITH MEMORY/DECODER/DRIVER



Physical Dimensions (Inches)



FEATURES

- Wide Viewing Angle, $\pm 40^\circ$
- Close Vertical Row Spacing, .800 Inches
- Rugged Solid Plastic Encapsulated Package
- Fast Access Time, 350 nSEC
- Compact Size For Hand Held Equipment
- Built-In Memory
- Built-In Character Generator
- Built-In Multiplex and LED Drive Circuitry
- Direct Access To Each Digit Independently and Asynchronously
- TTL Logic Levels, 5 Volt Power
- 17th Segment For Improved Punctuation Marks
- Low Power Consumption, Typically 10 mA per character

DESCRIPTION

The DL1414 is a four digit display module having 16 bar segments plus a decimal segment and a built-in CMOS integrated circuit.

The integrated circuit contains memory, ASCII character generator, and LED multiplexing and drive circuitry.

Inputs are TTL compatible. A single 5-volt power supply is required. Data entry is asynchronous and random access. A display system can be built using any number of DL1414's since each character in any DL1414 can be addressed independently and will continue to display the character last written until it is replaced by another.

LOADING DATA

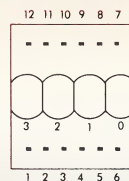
Loading data into the DL1414 is straightforward. The desired data code (D_0-D_6) and digit address (A_0, A_1) is presented in parallel and held stable during a write cycle. Data entry may be asynchronous and in random order. (Digit 0 is defined as right hand digit with $A_1 = A_0 = 0 = \text{low}$).

System interconnection is also straightforward. The least significant two address bits (A_0, A_1) are normally connected to the like named inputs of all DL1414's in the system. Data lines are connected to all DL1414's directly and in parallel. Multiple DL1414 systems usually use an external one-of-N decoder chip. The "write" pulse is connected to the CE of the decoder. A 3-to-8 line decoder multiplexer (74138) or a 4-to-16 line decoder/multiplexer (74154) are possible choices. All higher-order address bits (above A_1) become inputs to the decoder.

Specifications Subject To Change Without Notice

DL-1414 4-DIGIT 17 SEGMENT ALPHANUMERIC Intelligent Display™ WITH MEMORY/DECODER/DRIVER MARCH 1979

Pin	Function	Pin	Function
1	D5 Data Input	7	Gnd
2	D4 Data Input	8	D0 Data Input (LSB)
3	$\overline{WR}$ Write	9	D1 Data Input
4	A1 Digit Select	10	D2 Data Input
5	A0 Digit Select	11	D3 Data Input
6	V _{CC}	12	D6 Data Input (MSB)



TOP VIEW

OPTO-ELECTRONIC CHARACTERISTICS @ 25°C

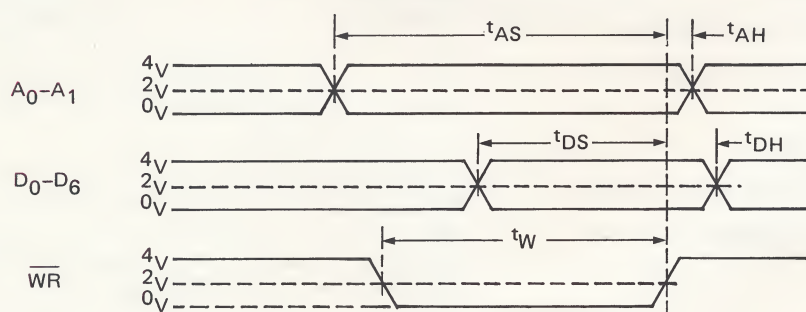
MAXIMUM RATINGS		OPTICAL CHARACTERISTICS		
Voltage, Any Pin Respect to GND	6 Volts	Luminous Intensity	8 Segments @ 5V	0.5 mcd
Operating Temperature	-20 to +70°C	Off Axis Viewing Angle (Note 1)		±40°
Storage Temperature	-20 to +70°C	Digit Size		112 mils
		Spectral Peak Wavelength		660 nm

ELECTRICAL CHARACTERISTICS @ 25°C

Parameters	Condition	Min	Typ	Max	Units
V _{CC}		4.5		5.5	Volts
I _{CC}	All Digits On (8 Segments/Digit) @ 5V		50	75	mA
I _{CC}	Display Blank @ 5V		0.5	1.0	mA
V _{IL} (Any Input)	V _{CC} = 5V			0.8	Volts
V _{IH} (Any Input)	V _{CC} = 5V	3.0			Volts
I _{IL} (Any Input)	V _{IL} = 0V V _{CC} = 5V			100	μA

SWITCHING CHARACTERISTICS @ 25°C

Symbol	Parameter	Units
t _W	Write Pulse	300 nS Min
t _{DS}	Data Setup Time	150 nS Min
t _{DH}	Data Hold Time	50 nS Min
t _{AS}	Address Setup Time	300 nS Min
t _{AH}	Address Hold Time	50 nS Min



WRITE CYCLE WAVEFORM

NOTE 1: "Off Axis Viewing Angle" is here defined as: "the minimum angle in any direction from the normal to the display surface at which any part of any segment in the display is not visible".

CHARACTER SET

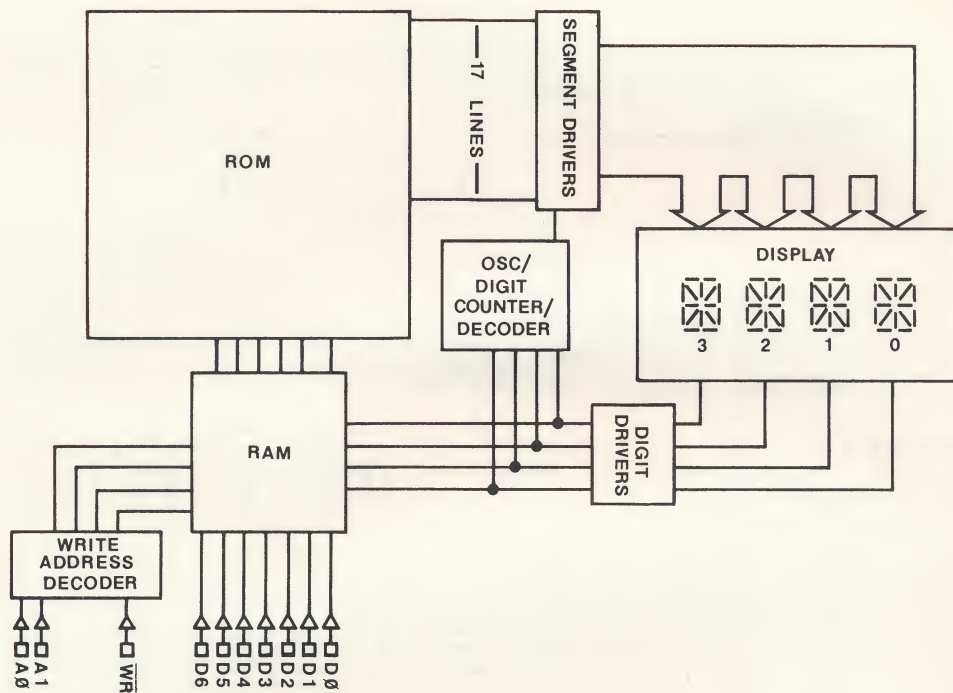
				D0	L	H	L	H	L	H	L	H
				D1	L	L	H	H	L	L	H	H
				D2	L	L	L	L	H	H	H	H
D6	D5	D4	D3									
L	H	L	L		!	"	#	\$	%	&	'	
L	H	L	H		<	>	*	+	,	--	.	/
L	H	H	L		0	1	2	3	4	5	6	7
L	H	H	H		8	9	:	;	/	=	\	?
H	L	L	L		a	b	c	d	e	f	g	
H	L	L	H		h	i	j	k	l	m	n	o
H	L	H	L		p	q	r	s	t	u	v	w
H	L	H	H		x	y	z	[	\	]	^	_

All Other Input Codes Display "Blank"

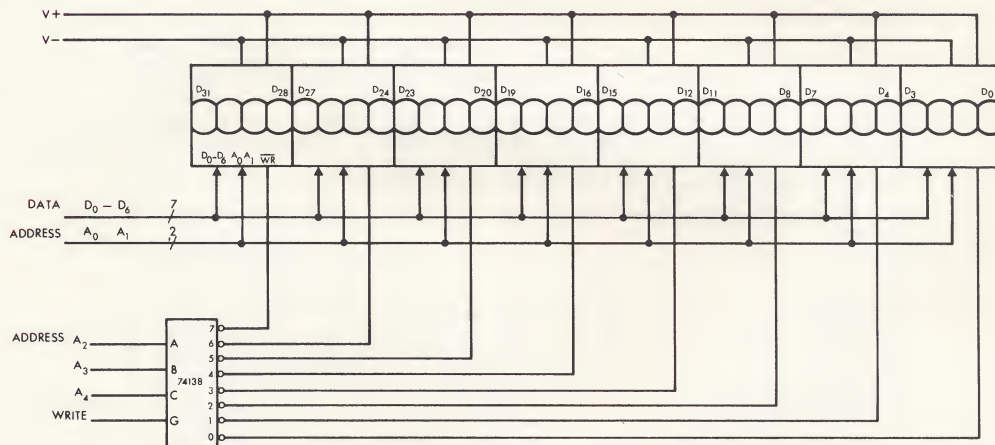
LOADING DATA

WR	ADDRESS		DATA INPUT								DIGIT 3	DIGIT 2	DIGIT 1	DIGIT 0
	A ₁	A ₀	D6	D5	D4	D3	D2	D1	D0					
H	X	X	X	X	X	X	X	X	X	NO CHANGE	NO CHANGE	NO CHANGE	NO CHANGE	
L	L	L	H	L	L	L	L	L	H	NO CHANGE	NO CHANGE	NO CHANGE	A	
L	L	H	H	L	L	L	L	H	L	NO CHANGE	NO CHANGE	B	A	
L	H	L	H	L	L	L	L	H	H	NO CHANGE	C	B	A	
L	H	H	H	L	L	L	H	L	L	D	C	B	A	
L	L	L	H	L	L	L	H	L	H	D	C	B	E	
L	H	L	H	L	L	H	L	H	H	D	K	B	E	
L	-	-	-	-	-	-	-	-	-	SEE CHARACTER SET				

X = DON'T CARE



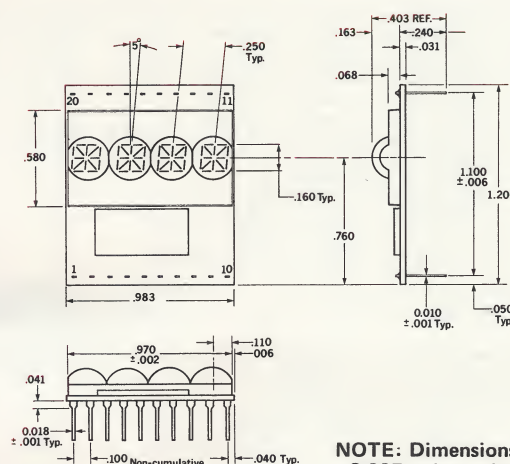
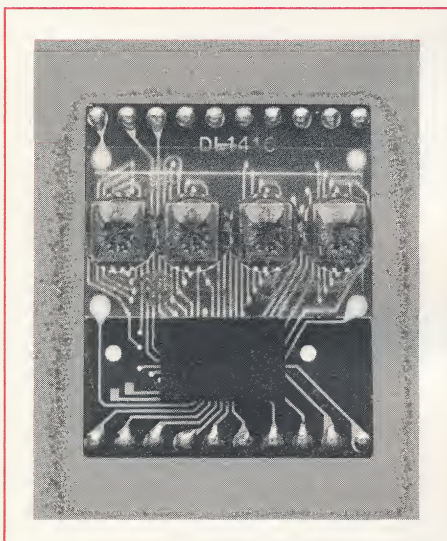
DL-1414 Block Diagram

TYPICAL INTERCONNECTION
FOR 32 DIGITS

litronix

DL-1416

4-DIGIT 16 SEGMENT ALPHANUMERIC INTELLIGENT DISPLAY WITH MEMORY/DECODER/DRIVER



NOTE: Dimensions in inches
± 0.005 unless otherwise
specified

FEATURES

- End-stackable, 4-Character Package
- High Contrast, 160 mil High, Magnified Monolithic Characters
- 64-Character ASCII Format
- Built-in Memory, Decoder, Multiplexer and Drivers
- Direct Access to Each Digit Independently and Asynchronously
- 5 Volt Logic, TTL Compatible
- 5 Volt Power Supply Only
- Independent Cursor Function

DESCRIPTION

The DL-1416 is a four digit display stick having a 16-segment font and a built-in CMOS integrated circuit driver.

The driver chip includes memory, ASCII ROM and multiplexing circuitry. Inputs are TTL compatible as is the power supply requirement. Each DL-1416 has its own one-of-four multiplexing built in. Data entry is asynchronous and random access. A display system can be built using any number of DL-1416's since each digit of each DL-1416 can be addressed independently. Each digit will continue to display the character last "written" until replaced by another.

System interconnection is very straight forward. The least significant two address bits (A_0 , A_1) are connected to the like named inputs of all DL-1416's in a system.

In small systems having 16 digits (4-DL-1416's), the enable ($\overline{CE}$) inputs of the four devices would simply be used directly to select the 4-digit groups. In larger displays, the $\overline{CE}$ inputs would come from 1-of-N decoder IC. In this case, address lines $A_2, \dots, A_N$ would go to the decoder inputs.

Data lines would be connected to all DL-1416's directly and in parallel, as would the "write" line ($\overline{W}$). The display will then behave as a "write-only-RAM."

The cursor function causes all 16 segments of a character to turn on. The cursor is *not* a character, however, and upon removal leaves the character unchanged. Normally, software would be used to cause the cursor to flash in certain selected digits under processor control.

LOADING CURSOR

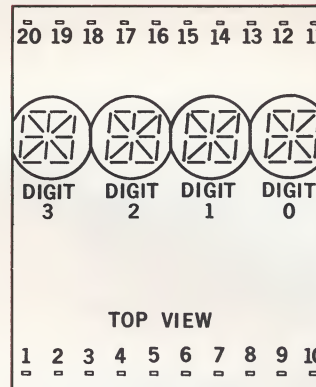
$\overline{CE}$ and $\overline{CU}$ are held low. A write ($\overline{W}$) pulse will now store the cursor in all digit positions for which the first four data lines (D_0, D_1, D_2, D_3) are held high. If previously stored, the cursors can only be removed if their respective data lines are held low while $\overline{CE}$, $\overline{CU}$ are low and write ($\overline{W}$) occurs. A "lamp test" function is realized by simply storing a cursor in all four digits of a display.

LOADING DATA

The chip enable ($\overline{CE}$) held low will enable data loading. The desired data code (D_0 - D_6) and selected digit address (A_0, A_1) should be held stable while write ($\overline{W}$) is low for storing new data. Data entry may be asynchronous and random.

Specification subject to change without notice.

Pin	Function	Pin	Function
1. D5	Data Input	11. A1	Digit Select
2. D4	Data Input	12. Unused	
3. D0	Data Input	13. Unused	
4. D1	Data Input	14. Unused	
5. D2	Data Input	15. Unused	
6. D3	Data Input	16. Unused	
7. $\overline{CE}$	Chip Enable	17. Unused	
8. $\overline{W}$	Write	18. V+	
9. $\overline{CU}$	Cursor Input	19. V-	
10. A0	Digit Select	20. D6	Data Input



MAXIMUM RATINGS

Operating Storage Temp.	-20°C to 70°C
Relative Humidity @ 60°C	90%
Operating Voltage	6 volts

ELECTRICAL CHARACTERISTICS @ 25° C

Parameters	Condition	Min	Typ	Max	Units
V _{cc}	@ 5V	4.5		5.5	Volts
I _{cc}	@ V _{cc} = 5V		35	100	mA
V _{IL} (all inputs)	@ V _{cc} = 5V			.4	Volts
V _{IH} (all inputs)	@ V _{cc} = 5V	2.4			Volts
I _{IL} (all inputs)	@ V _{cc} = 5V			125	μA

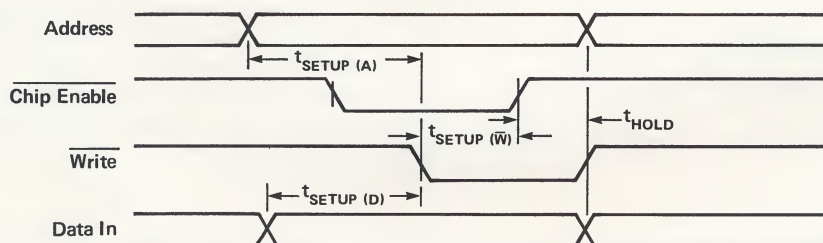
OPTICAL CHARACTERISTICS

Spectral Peak Wavelength	660nm Typ
Spectral Line Half-Width	40nm Typ
Viewing Angle	±20°
Digit Size	160 mils
Luminous Intensity	.5mcd/Seg @ V _{cc} = 5V

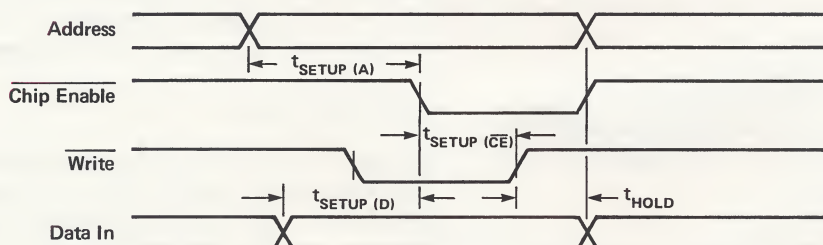
SWITCHING CHARACTERISTICS @ 5V

Parameter	Min	Unit
t _{SETUP (A)}	200	ns
t _{SETUP (D)}	200	ns
t _{SETUP (W)}	1300	ns
t _{SETUP (CE)}	1300	ns
t _{HOLD}	200	ns

WRITE CYCLE WAVEFORMS UTILIZING CHIP ENABLE ($\overline{CE}$)



WRITE CYCLE WAVEFORMS UTILIZING WRITE ($\overline{W}$)



AMENDED CHARACTERISTICS:**OPTICAL CHARACTERISTICS**

Spectral Peak Wavelength	660nm Typ
Spectral Line Half-Width	40nm Typ
Viewing Angle	+ 20°
Digit Size	160 mils
Luminous Intensity	.1mcd/Seg @ Vcc=5V

SWITCHING CHARACTERISTICS @ 5V

Parameter	Min	Unit
-----------	-----	------

t _{Setup} (A)	1000	ns
t _{Setup} (D)	1000	ns
t _{Setup} (W)	500	ns
t _{Setup} (CE)	500	ns
t _{Hold}	400	ns

OPERATING PRECAUTIONS**MAXIMUM RATINGS**

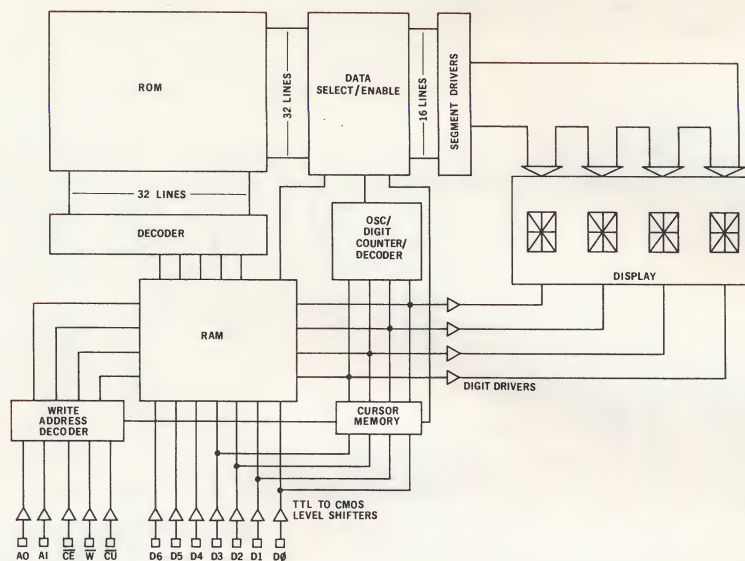
DC Supply Voltage	-0.5 to + 6.0 Vdc
Input Voltage, All Inputs	-0.5 to V ₊ + 0.5 Vdc
Relative Humidity @ 60°C	90%
Operating/Storage Temperature	-20°C to + 70°C

This CMOS device contains circuitry to protect the inputs against damage due to high static voltages or electric fields; however it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit. For proper operation it is recommended that all input voltages be constrained to the range $V_- \leq V \leq V_+$, particularly during power up conditions.

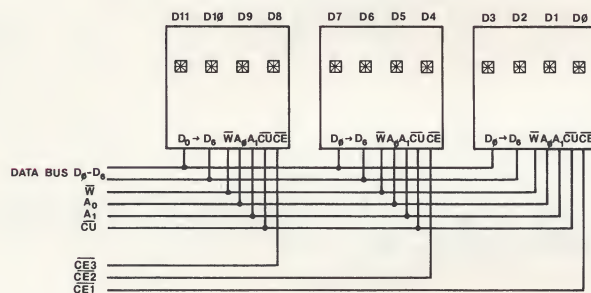
Unused inputs must be tied to an appropriate logic voltage level (either V₊ or V₋).

LOADING CURSORLOADING DATA

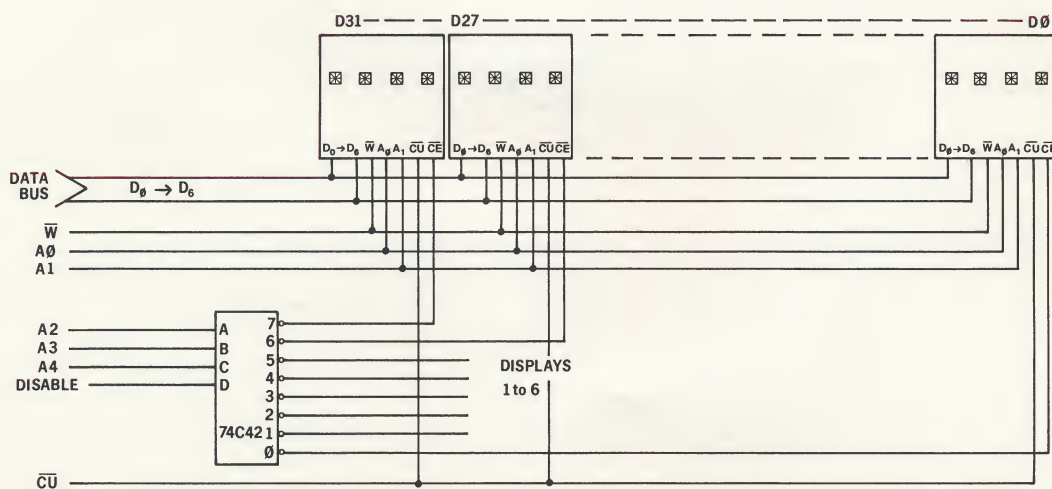
CHARACTER SET



INTERNAL SCHEMATIC



Typical interconnect
for small systems. 12digits

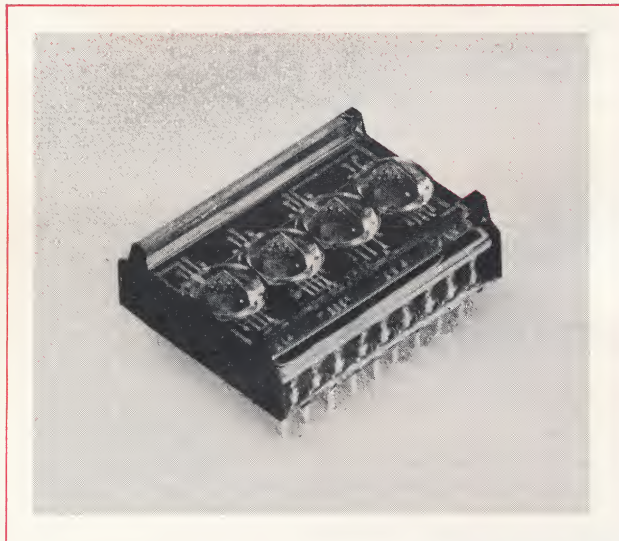


Typical schematic
for 32 digit systems

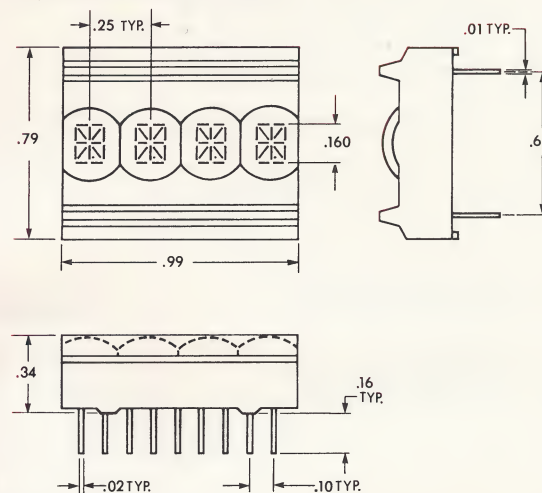
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DL-2416

4 DIGIT 16 SEGMENT PLUS DECIMAL ALPHANUMERIC Intelligent Display™ WITH MEMORY DECODER DRIVER



Physical Dimensions (Inches)



FEATURES

- Wide Viewing Angle $\pm 50^\circ$
- Close Vertical Row Spacing, .800 Inches
- Rugged Solid Plastic Encapsulated Package
- Fast Access Time, 350 nSEC
- Full Size Display for Stationary Equipment
- Built-in Memory
- Built-in Character Generator
- Built-in Multiplex and LED Drive Circuitry
- Direct Access to Each Digit Independently & Asynchronously
- TTL Logic Levels, 5 Volt Power
- Independent Cursor Function
- 17th Segment for Improved Punctuation Marks
- Memory Clear Function
- Display Blank Function

DESCRIPTION

The DL 2416 is a four digit display module having 16 segments plus decimal and a built-in CMOS integrated circuit.

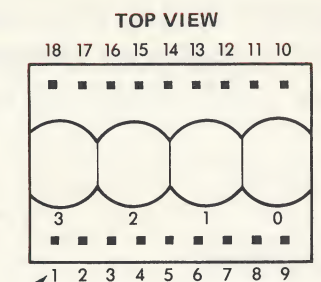
The integrated circuit contains memory, ASCII rom decoder, multiplexing circuitry, and drivers. Data entry is asynchronous and can be random. A display system can be built using any number of DL 2416's since each digit of any DL 2416 can be addressed independently and will continue to display the character last stored until replaced by another. System interconnection is very straightforward. The least significant two address bits (A_0 , A_1) are normally connected to the like named inputs of all DL 2416's in the system. With two chip enables ($\overline{CE1}$, and $\overline{CE2}$) four DL 2416's (16 characters) can easily be interconnected without a decoder.

Alternatively, one-of-n decoder IC's can be used to extend the address for large displays.

Data lines are connected to all DL 2416's directly and in parallel, as is the write line ($\overline{WR}$). The display will then behave as a "write-only memory". ("WOM").

The cursor function causes all segments of a digit position to illuminate. The cursor is *not* a character, however, and upon removal the previously displayed character will reappear.

Specification subject to change without notice.



Product Identification Marking.

Pin	Function	Pin	Function
1	$\overline{CE1}$ Chip Enable	10	Gnd
2	$\overline{CE2}$ Chip Enable	11	D0 Data Input
3	$\overline{CLR}$ Clear	12	D1 Data Input
4	CUE Cursor Enable	13	D2 Data Input
5	$\overline{CU}$ Cursor Select	14	D3 Data Input
6	$\overline{WR}$ Write	15	D6 Data Input
7	A1 Digit Select	16	D5 Data Input
8	A0 Digit Select	17	D4 Data Input
9	V_{CC}	18	$\overline{BL}$ Display Blank

OPTO-ELECTRONIC CHARACTERISTICS @ 25° C

MAXIMUM RATINGS

Voltage, any pin respect to gnd	6 Volts
Operating Temperature	-20° to + 70° C
Storage Temperature	-20° to + 70° C

OPTICAL CHARACTERISTICS

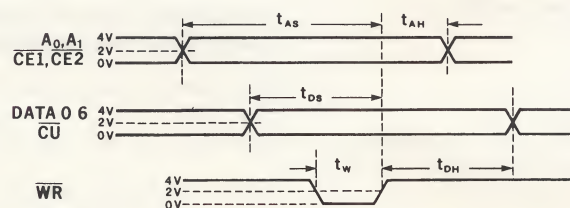
Luminous Intensity 8 Segments @ 5V	0.5 mcd
Off Axis Viewing Angle (Note 1)	± 50°
Digit Size	160 mils
Spectral Peak Wavelength	660 nm

ELECTRICAL CHARACTERISTICS @ 25° C

Parameter	Condition	Min	Typ	Max	Units
V_{CC}		4.5		5.5	Volts
I_{CC}	All Digits on (All Segments/Digit) @ 5V			150	mA
I_{CC}	All Digits on (8 Segments/Digit) @ 5V		100		mA
I_{CC}	Display Blank @ 5V		0.5	1.0	mA
V_{IL} (any input)	$V_{CC} = 5V$			0.8	Volts
V_{IH} (any input)	$V_{CC} = 5V$	3.0			Volts
I_{IL} (any input)	$V_{IL} = 0V \quad V_{CC} = 5V$			100	μA

SWITCHING CHARACTERISTICS @ 25° C

Symbol	Parameter	Units min
t_W	Write Pulse	200 nS
t_{DS}	Data Setup Time	100 nS
t_{DH}	Data Hold Time	50 nS
t_{AS}	Address Setup Time	300 nS
t_{AH}	Address Hold Time	0 nS
t_{CLR}	Clear Time (see text)	15 mS



Note 1: "Off Axis Viewing Angle" is here defined as: "the minimum angle in any direction from the normal to the display surface at which any part of any segment in the display is not visible".

LOADING DATA

Setting the chip enables ($\overline{CE1}$, $\overline{CE2}$) to their true state will enable data loading. The desired data code (D0-D6) and digit address (A_0 , A_1) should be held stable during the write cycle for storing new data.

Data entry may be asynchronous and random. (Digit 0 is defined as right hand digit with $A_1 = A_0 = 0$.)

Clearing of the entire internal four-digit memory can be accomplished by holding the clear ($\overline{CLR}$) low for one complete display multiplex cycle, 15 mS minimum.

$\overline{DO} = 1$; and will be removed if $\overline{DO} = 0$. Cursor will not be cleared by the $\overline{CLR}$ signal.

For those users not requiring the cursor, the cursor enable signal (CUE) may be tied low to disable display of the cursor function. A flashing cursor can be realized by simply pulsing CUE. If cursor has been loaded to any or all positions in the display, then CUE will control whether the cursor(s) or the characters appear. CUE does not affect the contents of cursor memory.

LOADING CURSOR

Setting the chip enables ($\overline{CE1}$, $\overline{CE2}$) and cursor select ($\overline{CU}$) to their true state will enable cursor loading. A write ($\overline{WR}$) pulse will now store or remove a cursor into the digit location addressed by A_0 , A_1 ; as defined in data entry. A cursor will be stored if

DISPLAY BLANKING

Blanking the display may be accomplished by loading a blank or space into each digit of the display or by using the ($\overline{BL}$) display blank input.

Setting the ($\overline{BL}$) input low does not affect the contents of either data or cursor memory. A flashing display can be realized by pulsing ($\overline{BL}$).

LOADING DATA

$\overline{BL}$	$\overline{CE1}$	$\overline{CE2}$	CUE	$\overline{CU}$	$\overline{WR}$	$\overline{CLR}$	A_1	A_0	D6	D5	D4	D3	D2	D1	D0	DIGIT 3	DIGIT 2	DIGIT 1	DIGIT 0
L	X	X	X	X	X	H	X	X	X	X	X	X	X	X	X	NC	NC	NC	NC
H	H	X	L	X	X	H	X	X	X	X	X	X	X	X	X	NC	NC	NC	NC
H	X	H	L	X	X	H	X	X	X	X	X	X	X	X	X	NC	NC	NC	NC
H	X	X	L	X	H	H	X	X	X	X	X	X	X	X	X	NC	NC	NC	NC
H	L	L	L	X	L	H	L	L	H	L	L	L	L	L	H	NC	NC	NC	A
H	L	L	L	X	L	H	L	H	H	L	L	L	L	H	L	NC	NC	B	A
H	L	L	L	X	L	H	H	L	H	L	L	L	L	H	H	NC	C	B	NC
H	L	L	L	X	L	H	H	H	H	L	L	L	H	L	L	D	C	NC	A
H	L	L	L	X	L	H	L	L	H	L	L	L	H	L	H	D	C	B	E
H	L	L	L	X	L	H	H	L	H	L	L	H	L	H	H	D	K	B	E
H	L	L	L	X	L	H	-	-	-	-	-	-	-	-	-	SEE CHARACTER SET			

LOADING CURSOR

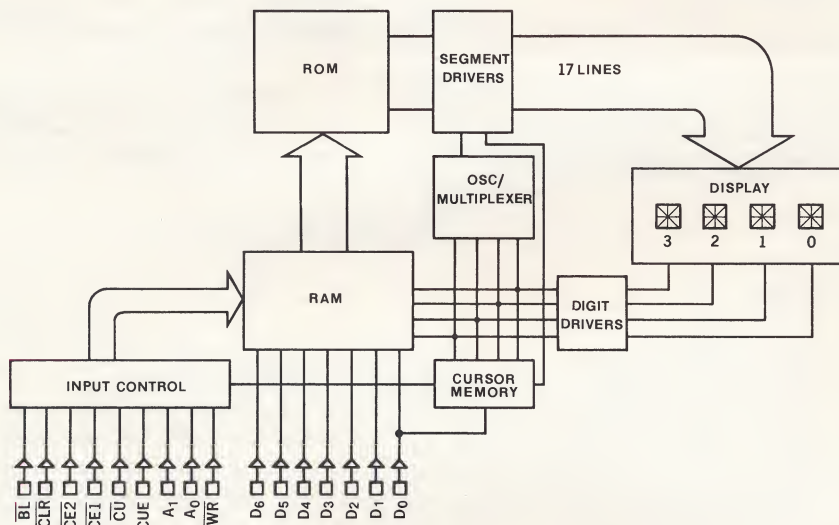
																Normal Data Entry			
																Enable Previous Stored Cursors			
H	L	L	L	X	X	H	X	X	X	X	X	X	X	X	X	NC	NC	NC	⊗
H	L	L	H	H	H	H	X	X	X	X	X	X	X	X	X	NC	NC	⊗	⊗
H	L	L	H	L	L	H	L	L	X	X	X	X	X	X	X	NC	⊗	⊗	⊗
H	L	L	H	L	L	H	H	L	X	X	X	X	X	X	X	NC	⊗	⊗	⊗
H	L	L	H	L	L	H	H	H	X	X	X	X	X	X	X	⊗	⊗	⊗	⊗
H	L	L	L	H	H	H	X	X	X	X	X	X	X	X	X	D	K	B	E
H	L	L	L	L	L	H	L	L	X	X	X	X	X	X	L	D	K	B	E
H	L	L	H	H	H	H	X	X	X	X	X	X	X	X	X	⊗	⊗	⊗	E

X = Don't care

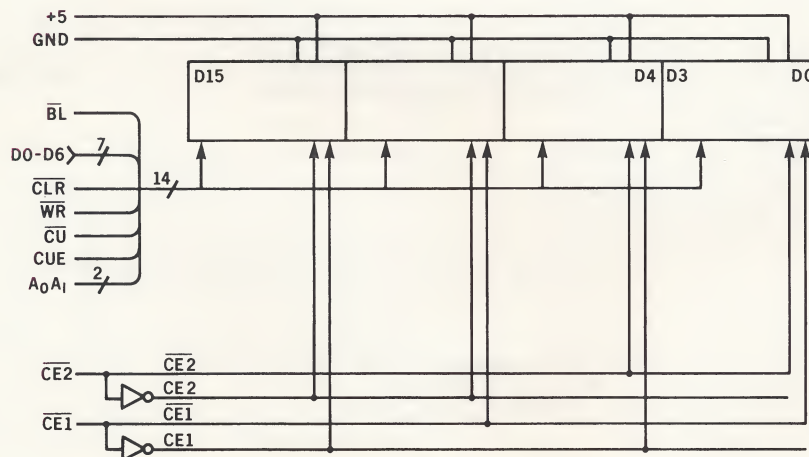
NC = No change from previously displayed characters

CHARACTER SET

		D0	L	H	L	H	L	H	L	H	L	H	L	H	L	H			
		D1	L	L	H	H	L	L	H	H	L	L	H	H	L	H			
		D2	L	L	L	L	H	H	H	H	L	L	L	H	H	H			
		D3	L	L	L	L	L	L	L	H	H	H	H	H	H	H			
D6	D5	D4	HEX	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
L	H	L	2		!	"	#	\$	%	&	'	<	>	*	+	,	--	.	/
L	H	H	3	0	1	2	3	4	5	6	7	8	9	:	:	<	=	>	?
H	L	L	4	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	
H	L	H	5	p	q	r	s	t	u	v	w	x	y	z	[	\	]	^	_



Internal Block Diagram



Typical Schematic for 16 Digit System



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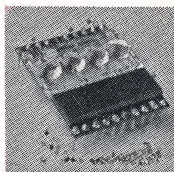
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You will find advanced products not available anywhere else. As well as widely-used standard devices at highly competitive prices.

Some highlights:

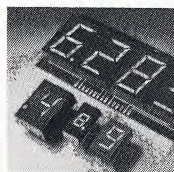
ALPHANUMERIC LED DISPLAYS.



Character sizes from 0.16" to 0.50" in end-stackable arrays of 1 to 4 red characters —

including an intelligent display that interfaces just like a RAM to μ P buses.

DIGITAL LED DISPLAYS.

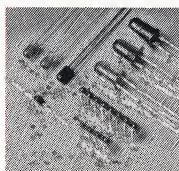


Green, yellow and red digits. Nine sizes from 0.1" to 1" high. In DIPs of 1 and 2 digits. On PCBs of

2 to 6 digits with edge connectors. Both light-pipe displays with very

wide viewing angle and low-cost reflector displays. 70 different types.

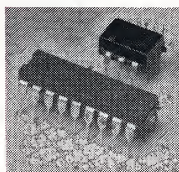
LED LAMPS.



Red, orange, yellow and green lamps. T-1, T-1 $\frac{3}{4}$ and axial packages. Arrays of 2 to 10 lamps. With

panel mounting clips. Lamps that flash on/off. Constant brightness lamps. Voltage-indicating lamps. 58 different types.

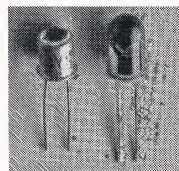
OPTO-ISOLATORS.



One, two and four-channel opto-isolators. Current transfer ratios up to 320%. Isolation voltages up to

5000v. Transmission rates as high as 4 megabits/sec. 15 JEDEC types. 25 different types in all.

IR EMITTING DIODES.



From medium to very high power. Beam widths from 6° to 60°. Hermetic and non-hermetic

TO-18 size. Miniature with axial or radial leads. 30 different types.

PHOTO-DETECTORS.

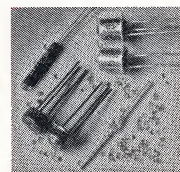
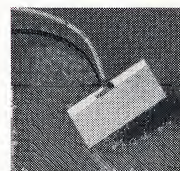


Photo-transistors and photo-diodes with acceptance angles from 6° to 73°. Hermetic high-reliability

devices and low-cost non-hermetic devices. TO-18 packages, ceramic packages and miniature radial lead configurations. Arrays of 2 to 10 detectors. 47 different types.

PHOTO-VOLTAIC CELLS.



Silicon solar cells. Sensitivity from .04 microamperes to 2.8 microamperes. Twelve different

types available.

litronix

AN AFFILIATE OF SIEMENS

THE LIGHTS FANTASTIC